California High-Speed Train Project

Request for Proposal for Design-Build Services

RFP No.: HSR 11-16
Stormwater Management Report
Ave 17 to Veterans Blvd

Prepared for

CALIFORNIA High-Speed Rail Authority

CALIFORNIA HIGH-SPEED TRAIN

Project Environmental Impact Report /
Environmental Impact Statement

Merced to Fresno Section
Draft EIR/EIS

Stormwater Management Plan

May 2011

CALIFORNIA
High-Speed Rail Authority

U.S. Department of Transportation
Federal Railroad Administration

CALIFORNIA HIGH-SPEED TRAIN PROJECT EIR/EIS

Stormwater Management Plan

Merced to Fresno Section

Prepared by:

CH2M HILL

May 2011

The purpose of this report is to summarize the Stormwater Management Plan (SWMP) for the California High-Speed Train (HST) Project between Merced and Fresno at the 15% design level. Information in this report is preliminary, commensurate with 15% design, and is expected to be updated and expanded as design advances.

This SWMP has been prepared under the supervision of the following Registered Civil Engineer. The undersigned attests to the technical information contained herein and the qualifications of any technical specialist providing engineering data upon which recommendations, conclusions, and decisions are based.

[INSERT STAMP] Peter Sturtevant 04/14/11

Peter Sturtevant, P.E. Date

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Acronyms and Abbreviations

BMPs	best management practices
Caltrans	California Department of Transportation
cfs	cubic feet per second
CSMP	Comprehensive Stormwater Management Plan
CRWQCBCVR	California Regional Water Quality Control Board Central Valley Region
FEMA	Federal Emergency Management Agency
GSRD	gross solids removal device
HDM	Highway Design Manual
HMF	heavy maintenance facility
HST	high-speed train
LID	low-impact development
LSed, MSed, HSed	three-tier sediment risk levels
LWat, HWat	two-tier receiving water risk levels
MAGPI	Merced Area Groundwater Pool Interests
MCTT	multi-chambered treatment trains
NALs	Numeric action levels
NELs	numeric effluent limitations
NPDES	National Pollution Discharge Elimination System
PPDG	Project Planning and Design Guide
QSP	Qualified SWPPP Practitioner
REAP	rain event action plan
RTP	Regional Transportation Plan
Central Valley RWQCB	Central Valley Regional Water Quality Control Board
SR 99	California State Highway Route 99
SWMM	Stormwater Management Model
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TDC	Targeted Design Constituent
TMDL	Total Maximum Daly Load
USEPA	U.S. Environmental Protection Agency
WQF	water quality flow
WQV	water quality volume

1.0 Introduction

1.1 Overview

The California High-Speed Train (HST) System, as shown in Figure 1-1, is planned to provide intercity, high-speed service on more than 800 miles of tracks throughout California, connecting the major population centers of Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego. The HST System is envisioned as a state-of-the-art, electrically powered, high-speed, steel-wheel-on-steel-rail technology, which will include contemporary safety, signaling, and automated train-control systems. The trains will be capable of operating at speeds of up to 220 miles per hour (mph) over a fully grade-separated, dedicated track alignment. Section 2.0 of this report provides a detailed description of the Merced to Fresno Section of the California High-Speed Train Project (HST Project).

Definition of HST System

The system that includes the HST tracks, structures, stations, traction powered substations, and maintenance facilities and train vehicles able to travel 220 mph.

Stormwater management is one of many important considerations when designing a transportation project. This Stormwater Management Plan (SWMP) provides a high-level plan for managing stormwater between Merced and Fresno at the 15% design level. Information in this report is preliminary, commensurate with the 15% design, and will be updated and expanded as design advances. Although possibly applicable to other sections of the HST, this SWMP was prepared specifically for the Merced to Fresno Section of the HST Project.

Three alternatives are being evaluated in the Draft EIR/EIS that is currently in preparation. The UPRR/SR 99 Alternative is generally adjacent to the existing transportation corridor defined by the UPRR Railway and State Route (SR) 99 corridor. The BNSF Alternative is essentially the same as the UPRR/SR 99 Alternative at the north and south ends of the alignment, but veers to the east to follow the BNSF Railroad corridor in the middle. The Hybrid Alternative consists of the northern portion of the UPRR/SR 99 Alternative and the southern portion of the BNSF Alternative. Each alternative includes design options for railroad wyes; a wye refers to the junction of the north-south alignment of the HST Project with the east-west alignment that would travel to the Bay Area. See Section 2 of this SWMP for more information about the HST alternatives.

The HST would result in numerous waterbody and floodplain crossings. The term *waterbody* encompasses relatively stationary water features such as ponds and reservoirs, and flowing water features such as streams, irrigation canals, major drainage ditches, and piped conduits. These include both perennially and intermittently flowing waterbodies. As used in this report, waterbodies do not include broader habitat, such as wetlands and vernal pools. Waterbody is distinguished in this report from floodplains, which are areas generally characterized by infrequent shallow flooding. HST engineering design considerations for waterbodies and floodplains are addressed in the *Hydraulics and Floodplain Draft Technical Report* (Authority and FRA 2011a).

Conventional train braking systems have been shown to be a source of metal pollutants. The HST Project would use electrically powered trains that have a regenerative braking system; this type of braking system would result in only minor physical brake wear. For stormwater purposes, electrically powered trains used in other cities have been determined to be non-polluting sources. These include the Metropolitan Transit system in San Diego and the Metro System in Los Angeles, as well as the light rail systems serving Seattle, Washington. Therefore, the HST linear features (rail line, at-grade embankment fill, and elevated structures) are assumed to be non-pollutant-generating surfaces and runoff from these surfaces will not require stormwater treatment.

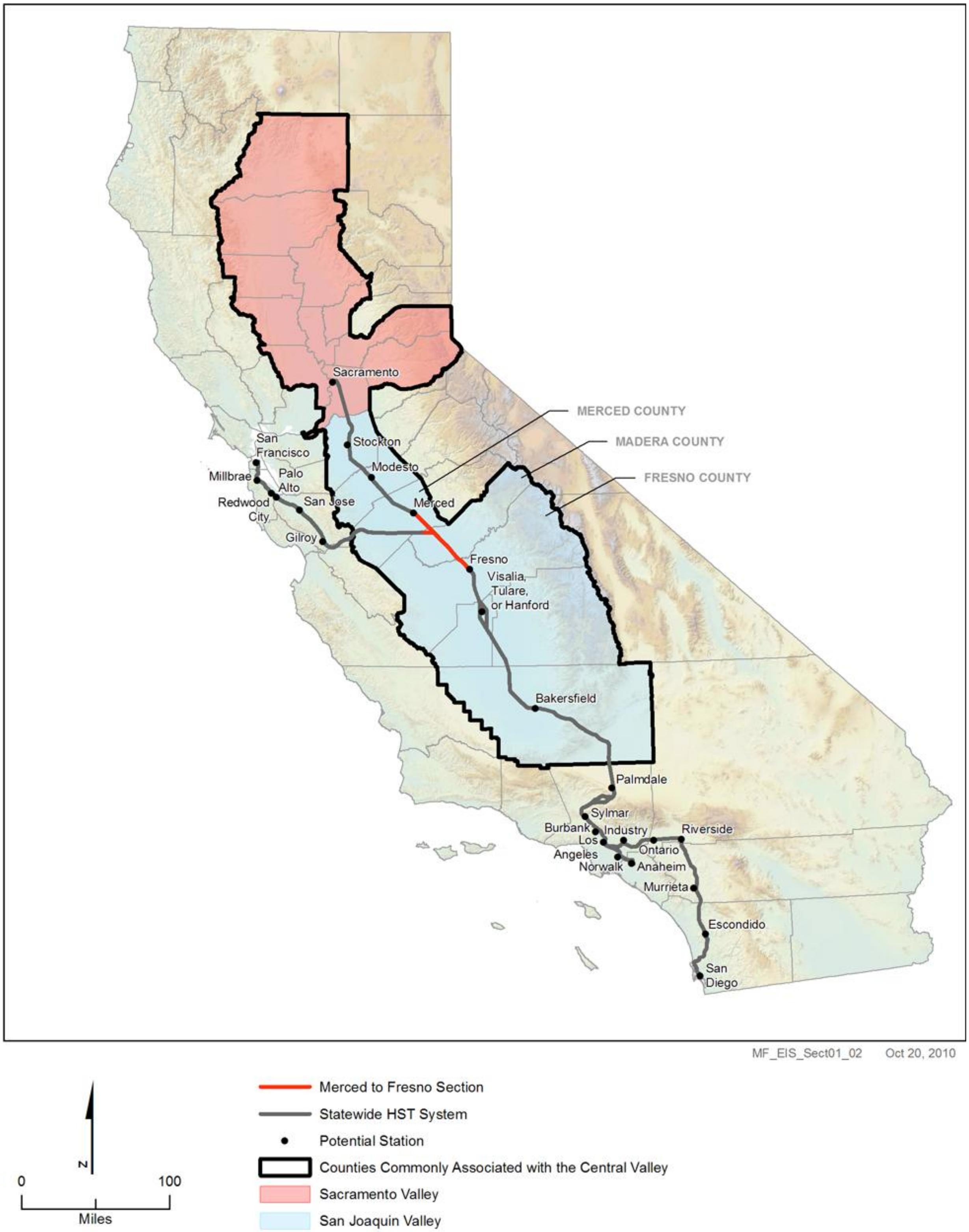


Figure 1-1
HST System in California

This SWMP summarizes a preliminary plan for stormwater management for the HST in the Merced to Fresno Section. The summary is high-level and consistent with a preliminary 15% design. The emphasis is on general conditions, requirements, and approaches, rather than site-specific stormwater management features, which will be identified in future phases of design. The emphasis of the SWMP is management of stormwater associated with the HST; however, it also addresses stormwater considerations for roads and highways that may be altered or relocated to accommodate the HST.

Although this SWMP summarizes stormwater considerations in urban settings, it does not directly address stormwater considerations for project modifications to state highways, such as SR 99, that fall under the jurisdiction of the California Department of Transportation (Caltrans). Stormwater considerations falling under Caltrans' regulations are addressed in a separate Stormwater Data Report, consistent with Caltrans requirements.

1.2 Report Organization

The report begins with this introduction, and is divided into the following sections, which address the following general topics:

- Section 2 – Project Description
- Section 3 – Hydrologic Setting
- Section 4 – Regulatory Setting
- Sections 5 – Runoff Interceptions and Conveyance Strategy
- Section 6 – Water Pollution Control Strategy
- Section 7 – Hydromodification Management
- Section 8 – Groundwater
- Section 9 – Conclusions
- Section 10 – References

1.3 Primary Sources

The primary sources of information for this SWMP were the Hydraulics and Floodplain Draft Technical Report (Authority and FRA 2011a), Stormwater Data Report (Authority and FRA 2010a), Caltrans' Stormwater Quality Handbook: Project Planning and Design Guide (PPDG; Caltrans 2010), Water Quality Control Plan for the Sacramento and San Joaquin River Basins (California Regional Water Quality Control Board Central Valley Region [CRWQCBCVR] 2009), Caltrans Highway Design Manual (HDM; Caltrans 2009a), and the Construction General Permit Fact Sheet (California Water Resources Control Board [SWRCB] 2009). Specific reference documents are listed in the Section 10, References, of this SWMP.

At this early stage in the project no contacts have been made with agencies having jurisdiction over stormwater issues. As the design proceeds, local agency contacts will be essential to identify and address local stormwater concerns and problem areas.

2.0 Project Description

The purpose of the Merced to Fresno Section of the HST Project is to implement the California HST System between Merced and Fresno, providing the public with electric-powered high-speed rail service that provides predictable and consistent travel times between major urban centers and connectivity to airports, mass transit systems, and the highway network in the south San Joaquin Valley, and to connect the northern and southern portions of the HST system. The approximately 65-mile-long corridor between Merced and Fresno is an essential part of the statewide HST System. The Merced to Fresno Section is the location where the HST would intersect and connect with the Bay Area and Sacramento branches of the HST System; it would provide a potential location for the heavy maintenance facility (HMF) where the HSTs would be assembled and maintained, as well as a test track for the trains; it would also provide Merced and Fresno access to a new transportation mode and would contribute to increased mobility throughout California.

2.1 No Project Alternative

The No Project Alternative refers to the projected growth planned for the region through the 2035 time horizon without the HST Project and serves as a basis of comparison for environmental analysis of the HST build alternatives. The No Project Alternative includes planned improvements to the highway, aviation, conventional passenger rail, and freight rail systems in the Merced to Fresno project area. There are many environmental impacts that would result under the No Project Alternative.

2.2 High-Speed Train Alternatives

As shown in Figure 2-1, there are three HST alignment alternatives proposed for the Merced to Fresno Section of the HST System: the UPRR/SR 99 Alternative, which would primarily parallel the UPRR railway; the BNSF Alternative, which would parallel the BNSF railway for a portion of the distance between Merced and Fresno; and the Hybrid Alternative, which combines features of the UPRR/SR 99 and BNSF alternatives. The alternatives may share the rail or state highway right-of-way in order to meet the project objective of using existing transportation corridors. In addition, there is an HST station proposed for both the City of Merced and the City of Fresno, there is a wye connection (see text box on page 2-3) west to the Bay Area, and there are five potential sites for a proposed HMF.

2.2.1 UPRR/SR 99 Alternative

This section describes the UPRR/SR 99 Alternative, including the Chowchilla design options, wyes, and HST stations.

A. NORTH-SOUTH ALIGNMENT

The north-south alignment of the UPRR/SR 99 Alternative would begin at the HST station in Downtown Merced. South of the station and leaving Downtown Merced, the alternative would cross under SR 99. Approaching the City of Chowchilla, the UPRR/SR 99 Alternative has two design options: the East Chowchilla design option, which would pass Chowchilla on the east side of town, and the West Chowchilla design option, which would pass Chowchilla 3 to 4 miles west of the city before turning back to rejoin the UPRR/SR 99 transportation corridor. These design options would take the following routes:

- **East Chowchilla design option:** This design option would transition from the west side of the UPRR/SR 99 corridor to an elevated structure as it crosses the UPRR railway and N Chowchilla Boulevard just north of Avenue 27, continuing on an elevated structure away from the UPRR corridor along the west side of and parallel to SR 99 to cross Berenda Slough. Toward the south side of Chowchilla, this design option would cross over SR 99 north of the SR 99/SR 152 interchange near Avenue 23½ south of Chowchilla. Continuing south on the east side of SR 99 and the UPRR corridor, this design option would transition to an at-grade profile near Avenue 22 in the community of

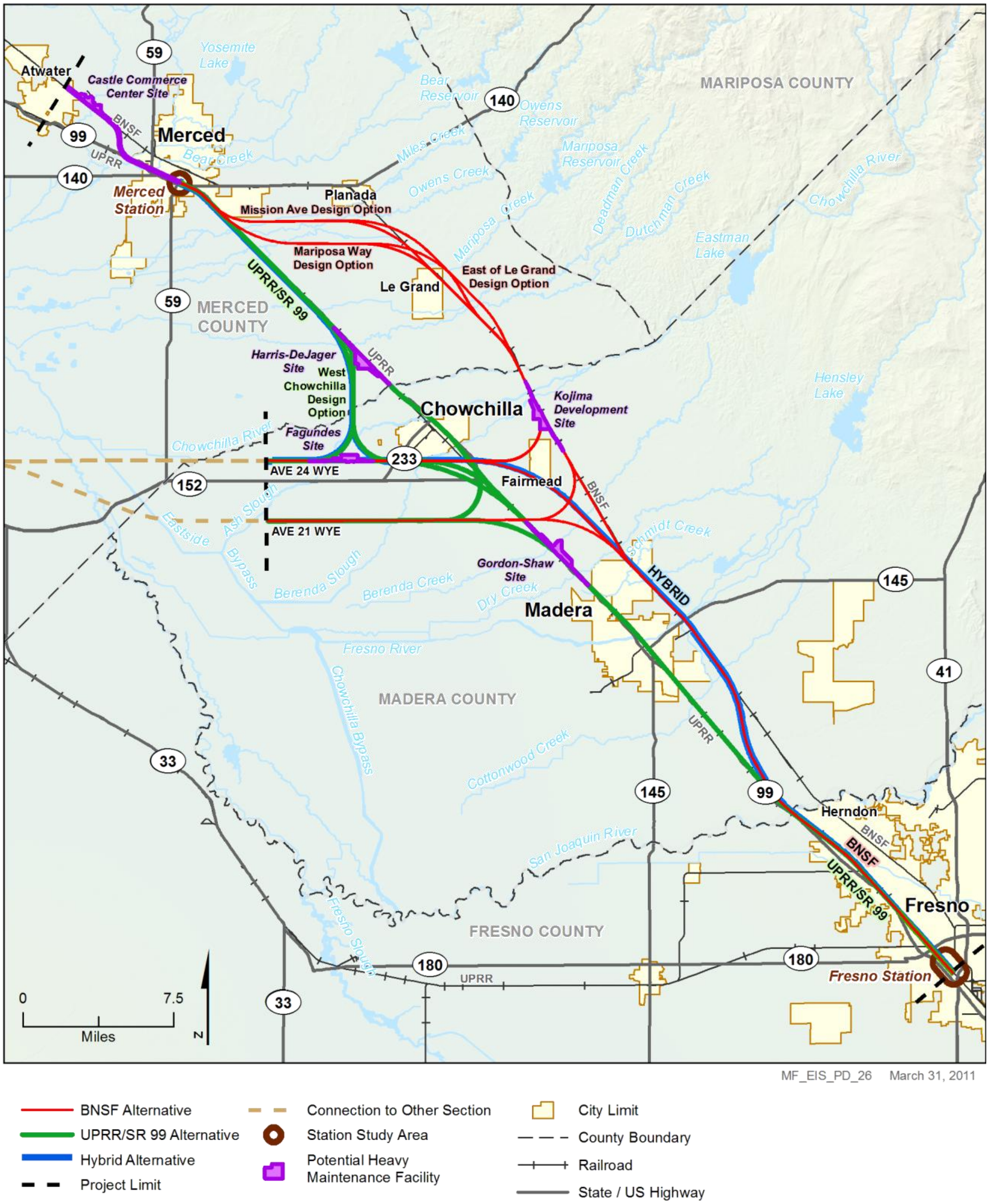


Figure 2-2
Merced to Fresno Section
HST Alternatives

Fairmead and remain at-grade for 5.1 miles through the community of Berenda until reaching the Dry Creek crossing. The East Chowchilla design option connects to the HST sections to the west via either the Ave 24 or Ave 21 wyes (described below).

- **West Chowchilla design option:** This design option would travel due south from Sandy Mush Road north of Chowchilla, following the west side of Road 11¾. The alignment would turn southeast toward the UPRR/SR 99 corridor and would connect with the east side of the UPRR right-of-way in Fairmead, south of Chowchilla. The West Chowchilla design option would result in a net decrease of approximately 8 miles of track compared to the East Chowchilla design option and would remain outside the limits of the City of Chowchilla. The West Chowchilla design option connects to the HST sections to the west via the Ave 24 Wye, but not the Ave 21 Wye.

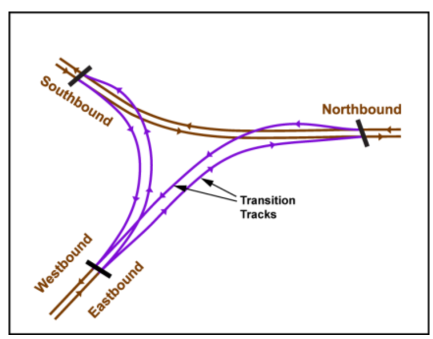
The UPRR/SR 99 Alternative would continue toward Madera along the east side of the UPRR and SR 99. After the alternative crosses the San Joaquin River, it would rise over the UPRR railway on an elevated guideway before crossing over the existing Herndon Avenue and again descending into an at-grade profile and continuing west of and parallel to the UPRR right-of-way. After elevating to cross the UPRR railway on the southern bank of the San Joaquin River, south of Herndon Avenue, the alternative would transition from an elevated to an at-grade profile. Traveling south from Golden State Boulevard at-grade, the alternative would cross under the reconstructed Ashlan Avenue and Clinton Avenue overhead structures. Advancing south from Clinton Avenue between Clinton Avenue and Belmont Avenue, the HST guideway would run at-grade adjacent to the western boundary of the UPRR right-of-way and then enter the HST station in Downtown Fresno. The HST guideway would descend in a retained-cut to pass under SR 180 and continue at-grade from approximately Calaveras Street into the station. As part of a station design option, Tulare Street would become either an overpass or undercrossing at the station.

B. WYE DESIGN OPTIONS

The following text describes the wye connection from the San Jose to Merced Section to the Merced to Fresno Section. There are two variations of the Ave 24 Wye for the UPRR/SR 99 Alternative because of the West Chowchilla design option. The Ave 21 Wye does not connect to the West Chowchilla design option and therefore does not have a variation.

What is a "Wye"?

The word "wye" refers to the "Y"-like formation that is created where train tracks branch off the mainline to continue in different directions. The transition to a wye requires splitting two tracks into four tracks that cross over one another before the wye "legs" can diverge in opposite directions to allow bidirectional travel. For the Merced to Fresno Section of the HST System, the two tracks traveling east-west from the San Jose to Merced Section must become four tracks—a set of two tracks branching to the north and a set of two tracks branching to the south.



Ave 24 Wye

The Ave 24 Wye design option would travel along the south side of eastbound Avenue 24 toward the UPRR/SR 99 Alternative and would begin diverging onto two sets of tracks west of Road 11 and west of the City of Chowchilla. One set of tracks would travel to the northeast of Road 12, joining the UPRR/SR 99 north-south alignment on the west side of the UPRR railway just north of Sandy Mush Road. The southbound HST guideway would continue east along Avenue 24, turning south near SR 233 southeast of Chowchilla, crossing SR 99 and the UPRR railway to connect to the UPRR/SR 99 Alternative on the east side of the UPRR near Avenue 21½.

Figure 2-2a shows the wye alignment for the East Chowchilla design option and Figure 2-2b shows the alignment for the West Chowchilla design option. Together, the figures illustrate the difference in the wye triangle formation for each design option connection. The north-south alignment of the West Chowchilla design option between Merced and Fresno diverges along Avenue 24 onto Road 12, on the north branch of the wye, allowing the

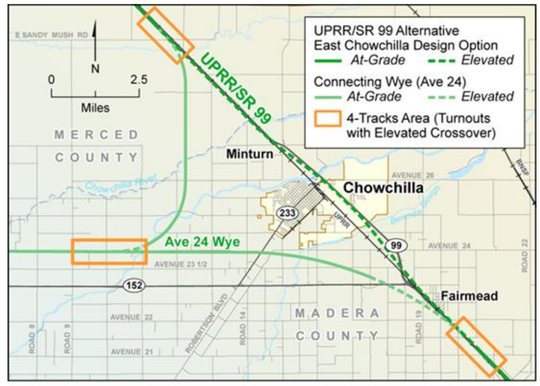
HST alternative to avoid traveling through Chowchilla and to avoid constraining the city within the wye triangle.

Ave 21 Wye

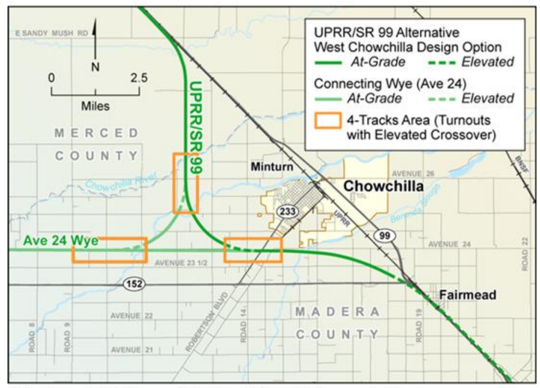
The Ave 21 Wye would travel along the north side of Avenue 21. Just west of Road 16, the HST tracks would diverge north and south to connect to the UPRR/SR 99 Alternative, with the north leg of the wye joining the north-south alignment at Avenue 23½ and the south leg at Avenue 19½.

C. HST STATIONS

The Downtown Merced and Downtown Fresno station areas would each occupy several blocks, to include station plazas, drop-offs, a multimodal transit center, and parking structures. The areas would include the station platform and associated building and access structure, as well as lengths of platform tracks to accommodate local and express service at the stations. As currently proposed, both the Downtown Merced and Downtown Fresno stations would be at-grade, including all trackway and platforms, passenger services and concessions, and back-of-house functions.



(a) Ave 24 Wye with the East Chowchilla Design Option



(b) Ave 24 Wye with the West Chowchilla Design Option

Figure 2-2a and b
Ave 24 Wye and Chowchilla Design Options

Downtown Merced Station

The Downtown Merced Station would be between Martin Luther King Jr. Way to the northwest and G Street to the southeast. The station would be accessible from both sides of the UPRR, but the primary station house would front 16th Street. The major access points from SR 99 include V Street, R Street, Martin Luther King Jr. Way, and G Street. Primary access to the parking facility would be from West 15th Street and West 14th Street, just one block east of SR 99. The closest access to the parking facility from the SR 99 freeway would be R Street, which has a full interchange with the freeway. The site proposal includes a parking structure that would have the potential for up to 6 levels with a capacity of approximately 2,250 cars and an approximate height of 50 feet.

Downtown Fresno Station Alternatives

There are two station alternatives under consideration in Fresno: the Mariposa Street Station Alternative and the Kern Street Station Alternative.

Mariposa Street Station Alternative

The Mariposa Street Station Alternative is located in Downtown Fresno, less than 0.5 mile east of SR 99. The station would be centered on Mariposa Street and bordered by Fresno Street on the north, Tulare Street on the south, H Street on the east, and G Street on the west. The station building would be approximately 75,000 square feet, with a maximum height of approximately 60 feet. The two-level station would be at-grade, with passenger access provided both east and west of the HST guideway and the UPRR tracks, which would run parallel with one another adjacent to the station. Entrances would be located at both G and H Streets. The eastern entrance would be at the intersection of H Street and Mariposa Street, with platform access provided via the pedestrian overcrossing. The main western entrance would be located at G Street and Mariposa Street.

The majority of station facilities would be located east of the UPRR tracks. The station and associated facilities would occupy approximately 13 acres, including 7.5 acres dedicated to the station, bus transit center, surface parking lots, and kiss-and-ride accommodations. A new intermodal facility would be included in the station footprint on the parcel bordered by Fresno Street to the north, Mariposa Street to the south, Broadway Street to the east, and H Street to the west. The site proposal includes the potential for up to 3 parking structures occupying a total of 5.5 acres. The first parking structure would sit on 1.75 acres, with 5 levels and a capacity of approximately 1,300 cars. The second parking structure would sit on 2.25 acres, with 5 levels and a capacity of approximately 1,700 cars. The third parking structure would have a slightly smaller footprint (1.5 acres), with 5 levels and a capacity of approximately 1,100 cars. Surface parking lots would provide approximately 800 additional parking spaces.

Kern Street Station Alternative

The Kern Street Station Alternative for the HST station would also be in Downtown Fresno and would be centered on Kern Street between Tulare Street and Inyo Street. This station would include the same components as the Mariposa Street Station Alternative but would not encroach on the historic Southern Pacific Railroad depot just north of Tulare Street and would not require relocation of existing Greyhound facilities. Two of the 3 potential parking structures would each sit on 2 acres and each would have a capacity of approximately 1,500 cars. The third structure would have a slightly smaller footprint (1.5 acres) and have a capacity of approximately 1,100 cars. Surface parking lots would provide approximately 600 additional parking spaces. Like the Mariposa Street Station Alternative, the majority of station facilities under the Kern Street Station Alternative would be east of the HST tracks.

2.2.2 BNSF Alternative

This section describes the BNSF Alternative, including the Le Grand design options and wyes. It does not include a discussion of the HST stations, because the station descriptions are identical for each of the three HST alignment alternatives.

A. NORTH-SOUTH ALIGNMENT

The north-south alignment of the BNSF Alternative would begin at the proposed Downtown Merced HST Station. This alternative would remain at-grade through Merced and would cross under SR 99 at the south end of the city. Just south of the interchange at SR 99 and E Childs Avenue, the BNSF Alternative would cross SR 99 and UPRR as it begins to curve to the east, crossing over the E Mission Avenue interchange. It would then travel east to the vicinity of Le Grand, where it would turn south and travel adjacent to the BNSF tracks.

To minimize impacts on the natural environment and the community of Le Grand, the project design includes four design options:

- **Mission Ave design option:** This design option would turn east to travel along the north side of Mission Avenue at Le Grand and then would elevate through Le Grand adjacent to and along the west side of the BNSF corridor.
- **Mission Ave East of Le Grand design option:** This design option would vary from the Mission Ave design option by traveling approximately 1 mile farther east before turning southeast to cross Santa Fe Avenue and the BNSF tracks south of Mission Avenue. The HST alignment would parallel the BNSF for a half-mile to the east, avoiding the urban limits of Le Grand. This design option would cross Santa Fe Avenue and the BNSF railroad again approximately one-half mile north of Marguerite Road and would continue adjacent to the west side of the BNSF corridor.
- **Mariposa Way design option:** This design option would travel 1 mile farther southeast than the Mission Ave design option before crossing SR 99 near Vassar Road and turning east toward Le Grand along the south side of Mariposa Way. East of Simonson Road, the HST alignment would turn to the southeast. Just prior to Savana Road in Le Grand, the HST alignment would transition from at-grade

to elevated to pass through Le Grand on a 1.7-mile-long guideway adjacent to and along the west side of the BNSF corridor.

- **Mariposa Way East of Le Grand design option:** This design option would vary from the Mariposa Way design option by traveling approximately 1 mile farther east before turning southeast to cross Santa Fe Avenue and the BNSF tracks less than one-half mile south of Mariposa Way. The HST alignment would parallel the BNSF to the east of the railway for a half-mile, avoiding the urban limits of Le Grand. This design option would cross Santa Fe Avenue and the BNSF again approximately a half-mile north of Marguerite Road and would continue adjacent to the west side of the BNSF corridor.

Continuing east along the west side of BNSF, the HST alternative would begin to curve southeast just before Plainsburg Road through a predominantly rural and agricultural area. One mile south of Le Grand, the HST alignment would cross Deadman and Dutchman creeks. The HST alternative would deviate from the BNSF corridor just southeast of S White Rock Road, where it would remain at-grade for another 7 miles, except at the bridge crossings, and would continue on the west side of the BNSF corridor through the community of Sharon. The HST alignment would continue at-grade through the community of Kismet until crossing at Dry Creek. The BNSF Alternative would then continue at-grade through agricultural areas along the west side of the BNSF corridor through the community of Madera Acres north of the City of Madera. South of Avenue 15 east of Madera, the alignment would transition toward the UPRR corridor, following the east side of the UPRR corridor near Avenue 9 south of Madera, then continuing along nearly the same route as the UPRR/SR 99 Alternative over the San Joaquin River to enter the community of Herndon. After crossing the San Joaquin River, the alignment would be the same as for the UPRR/SR 99 Alternative

B. WYE DESIGN OPTIONS

The Ave 24 Wye and the Ave 21 Wye would be the same as described for the UPRR/SR 99 Alternative (East Chowchilla design option), except as noted below.

Ave 24 Wye

As with the UPRR/SR 99 Alternative, the Ave 24 Wye would follow along the south side of Avenue 24 and would begin diverging into two sets of tracks (i.e., four tracks) beginning west of Road 17. Two tracks would travel north near Road 20½, where they would join the north-south alignment of the BNSF Alternative on the west side of the BNSF corridor near Avenue 26½. The two southbound tracks would join the BNSF Alternative on the west side of the BNSF corridor south of Avenue 21.

Ave 21 Wye

As with the UPRR/SR 99 Alternative, the Ave 21 Wye would travel along the north side of Avenue 21. Two tracks would diverge, turning north and south to connect to the north-south alignment of the BNSF Alternative just west of Road 21. The north leg of the wye would join the north-south alignment just south of Avenue 24 and the south leg would join the north-south alignment just east of Frontage Road/Road 26 north of the community of Madera Acres.

2.2.3 Hybrid Alternative

This section describes the Hybrid Alternative, which generally follows the alignment of the UPRR/SR 99 Alternative in the north and the BNSF Alternative in the south. It does not include a discussion of the HST stations, because the station descriptions are identical for each of the three HST alignment alternatives.

A. NORTH-SOUTH ALIGNMENT

From north to south, generally, the Hybrid Alternative would follow the UPRR/SR 99 alignment with the West Chowchilla design option; at the Ave 24 Wye connection, it would join the BNSF Alternative and would continue south over the San Joaquin River on to the Fresno Station.

Approaching the Chowchilla city limits, the Hybrid Alternative would veer due south from Sandy Mush Road along a curve and would continue at-grade for 4 miles parallel to and on the west side of Road 11¾. The Hybrid Alternative would curve to a corridor on the south side of Avenue 24 and would travel parallel for the next 4.3 miles. Along this curve, the southbound HST track would become an elevated structure for approximately 9,000 feet to cross over the Ave 24 Wye connection tracks and Ash Slough, while the northbound HST track would remain at-grade. Continuing east on the south side of Avenue 24, the HST alignment would become identical to the Ave 24 Wye connection for the BNSF Alternative and would follow the alignment of the BNSF Alternative until crossing the San Joaquin River, where it becomes the same as for the UPRR/SR 99 Alternative.

B. WYE DESIGN OPTIONS

The wye connection for the Hybrid Alternative is along Avenue 24 and matches the combination of the UPRR/SR 99 Alternative with the West Chowchilla design option, then generally follows the Ave 24 Wye alignment for the BNSF Alternative. The Hybrid Alternative does not have an Ave 21 Wye design option.

2.2.4 Heavy Maintenance Facility Alternatives

The Authority is studying five HMF sites (see Figure 2-1) within the Merced to Fresno Section, one of which may be selected.

- **Castle Commerce Center HMF site** – A 272-acre site located 6 miles northwest of Merced, at the former Castle Air Force Base in northern unincorporated Merced County. It is adjacent to and on the east side of the BNSF mainline, 1.75 miles south of the UPRR mainline, off of Santa Fe Drive and Shuttle Road, 2.75 miles from the existing SR 99 interchange. The Castle Commerce Center HMF would be accessible by all HST alternatives.

- **Harris-DeJager HMF site** – A 383-acre site located north of Chowchilla adjacent to and on the west side of the UPRR corridor, along S Vista Road and near the SR 99 interchange under construction. The Harris-DeJager HMF would be accessible by the UPRR/SR 99 Alternative with the Ave 21 Wye.

- **Fagundes HMF site** – A 222-acre site, located 3 miles southwest of Chowchilla on the north side of SR 152, between Road 11 and Road 12. This HMF would be accessible by all HST alternatives with the Ave 24 Wye.

- **Gordon-Shaw HMF site** – A 306-acre site adjacent to and on the east side of the UPRR corridor, extending from north of Berenda Boulevard to Avenue 19. The Gordon-Shaw HMF would be accessible from the UPRR/SR 99 Alternative with the Ave 24 Wye.

- **Kojima Development HMF site** – A 343-acre site on the west side of the BNSF corridor east of Chowchilla, located along Santa Fe Drive and Robertson Boulevard (Avenue 26). The Kojima Development HMF would be accessible by the BNSF Alternative with the Ave 21 Wye.

3.0 Hydrologic Setting

3.1 Study Area

Hydraulic considerations for the Merced to Fresno Section of the HST Project are described in considerable detail in *Hydraulics and Floodplain Technical Report* (Authority and FRA 2011a). This report identifies and characterizes the waterbody crossings (natural and manmade) along both the UPRR/SR 99 and BNSF alignment corridors. The report also summarizes relevant hydraulic and hydrologic regulations, floodplain issues, hydraulic design requirements and considerations, design flows for crossings, and plans for completing hydraulic modeling and permitting requirements.

Watersheds for the major streams crossed by the HST Project generally extend into the Sierra Nevada foothills and/or mountains. The streams flow northeast to southwest or east to west toward the San Joaquin River, which drains the Central Valley south of Sacramento (see Figure 2-1). At the HST alignments, most of the streams have some flood control in the form of upstream reservoirs and/or upstream diversions.

The study area covers the area roughly defined by the cities of Merced and Atwater to the north, Fresno to the south, the San Joaquin River to the west, and the Sierra Nevada foothills and reservoirs to the east. The study area generally has low gradients, typically less than 1%. Because of these low gradients, the potential hydraulic impacts due to an HST Project water crossing could, in some cases, extend several thousand feet upstream and downstream.

3.2 Broad Hydrologic Characteristics

Winter snowfalls in the Sierra Nevada Mountains contribute to reservoir storage and groundwater recharge. Along the HST corridor, the climate is Mediterranean, characterized by long, dry summers and mild, moderately wet winters. The average annual precipitation is about 11 inches, with typically less than 10% of that total falling during the 5-month period from May to September. Three types of storms produce precipitation in the area: general winter storms, thunderstorms, and tropical cyclones called the "pineapple express." Flooding is most often caused by high intensity rainfall during general winter storms, and severe flooding can result from tropical cyclones.

Because of the generally low rainfall in this portion of the Central Valley, agriculture is heavily dependent on irrigation. A vast network of irrigation canals (Figure 3-1) crisscrosses the valley floor, with major flows originating near the HST corridor that are derived from upstream storage. Both irrigation flows and stormwater are conveyed through the irrigation network, as well as by natural streams. All of the streams along the HST corridor are ultimately tributary to the San Joaquin River. Many of these tributary streams are ephemeral or intermittent, meaning that they only contain water after it rains. Supplemental groundwater pumping has resulted in subsidence along the HST corridor, as described in Section 8. Historically, irrigation depletions and infiltration promoted by groundwater declines have severely reduced San Joaquin River base flows. These patterns of decline are changing due to recent restoration efforts to restore salmonids to the San Joaquin River.

Major urban centers along the HST alignment are Merced near the north end and Fresno at the south end; passenger stations are planned in both cities. Madera is a moderate-sized suburban city in the central portion of the Merced to Fresno Section. Smaller towns include Chowchilla and Le Grand, while minor communities include Fairmead, Berenda, Sharon, and Kismet. Land use upstream of the HST Project and between the cities is rural agriculture or undeveloped. Few trees exist along the HST alignments, except in orchards and along the banks of major stream channels.

Soil groups within the study area have been mapped and classified according to criteria determined by the U.S. Department of Agriculture Natural Resources Conservation Service (formerly known as the Soil Conservation Survey). Based on these criteria, soils are further classified into four hydrological soil groups: A, B, C, and D, where A soils have relatively high infiltration rates (and low runoff potential;

i.e., sand and gravel), and D soils have very low infiltration rates (and high runoff potential: e.g., clay soils or soils with a shallow water table). All four soil types are present within the study area, distributed as shown on Figure 3-2. The soils in the southern portion of the study area, south of the San Joaquin River, are largely Class D with some Class C soils. Class D soils also predominate in the central portion of the study area, but Class B soils are common. In the northern portion of the study area, Class B and C soils are common. Small bands of Class A soils can be found in the central and northern portions of the study area.

3.3 Major Watersheds

A map of major watershed boundaries would be somewhat misleading because of the large number of diversions and interconnections for irrigation conveyance and flood management. However, Table 3-1 lists the 18 natural, named waterbodies, from north to south, along the downgradient UPRR/SR 99 alignment; the table also lists the waterbody jurisdictional classification, the nominal area of each watershed, a summary of the major land uses in the watershed, and the modeled mean annual flow rate (U.S. Environmental Protection Agency [USEPA] 2010a). The modeled mean annual flow rate was developed as part of the National Hydrography Dataset Plus using the Unit Runoff Method calibrated to U.S. Geological Survey (USGS) gage sites (USEPA 2007).

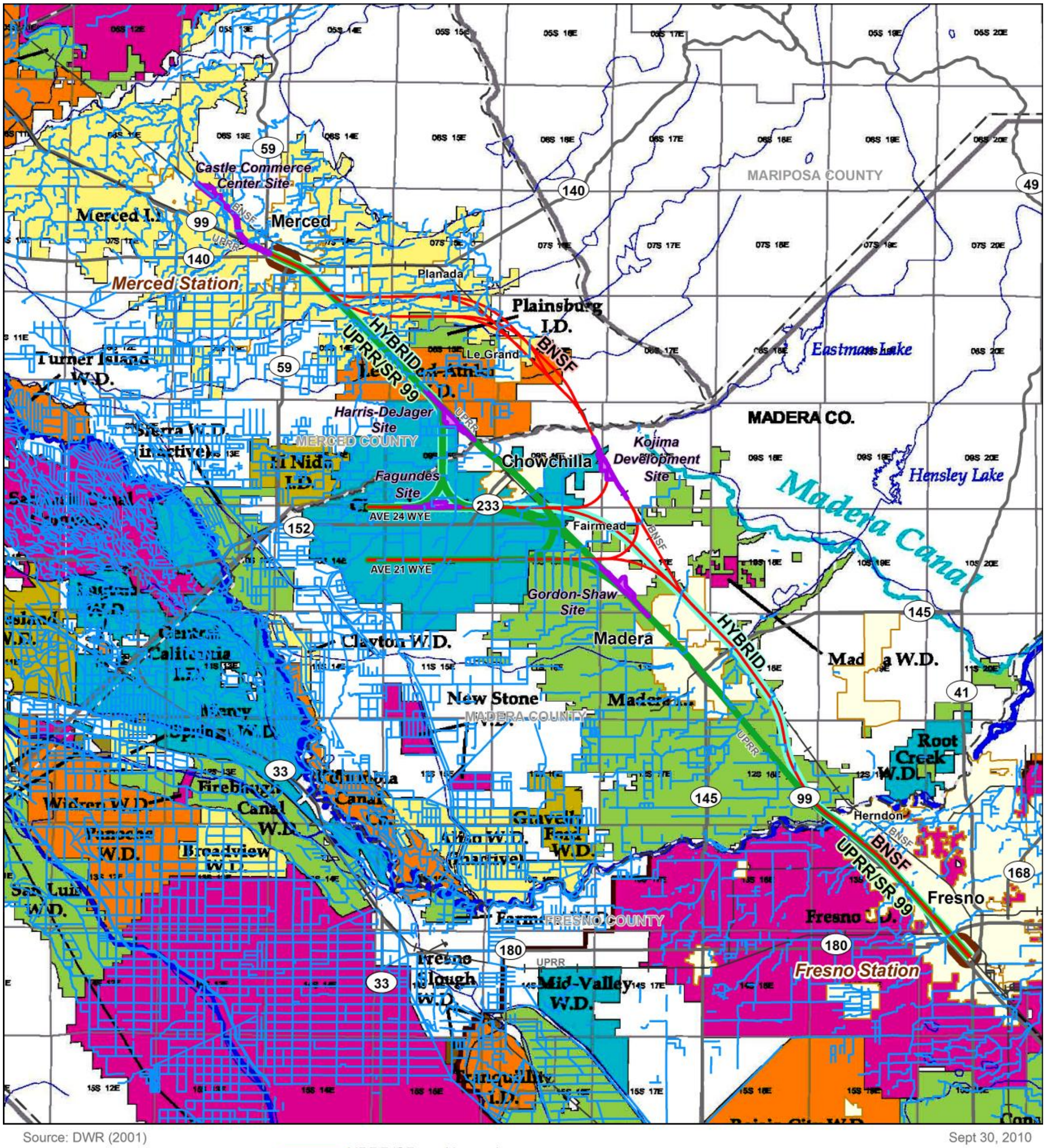


Figure 3-1
Irrigation Conveyance and
Irrigation District Boundaries

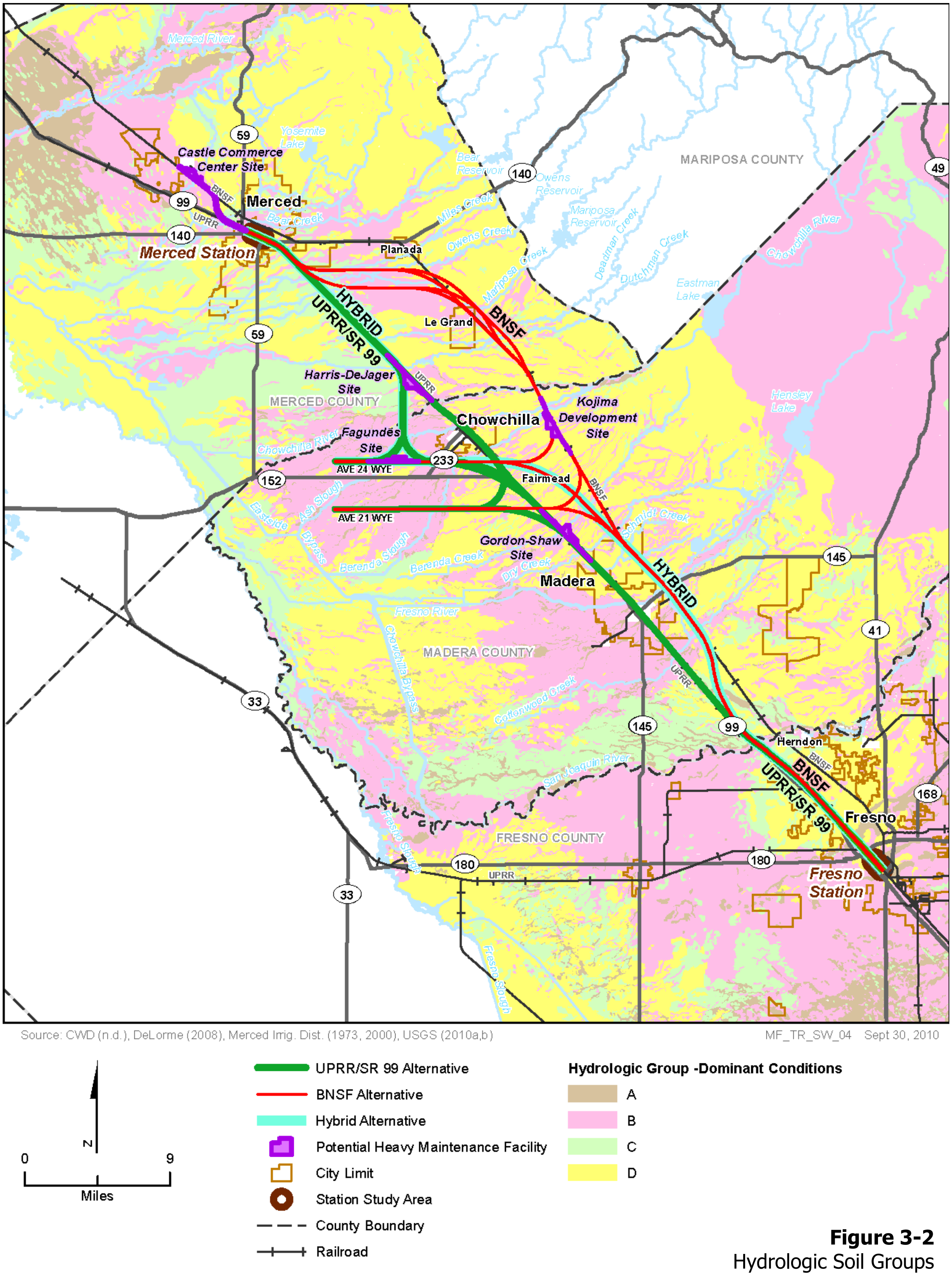


Figure 3-2
Hydrologic Soil Groups

Table 3-1
Watershed and Stream Characteristics

Named Natural Waterbody	Classification	Nominal Watershed Area (sq. mi.)	Top 3 Land Uses (%)	Mean Annual Flow Rate (modeled) (cfs)
Canal Creek	Regulated Stream/ Irrigation Canal	36.2	72% grassland 12% orchard 8% pasture	29
Black Rascal Creek	Regulated Stream	47.3	54% grassland 18% pasture 9% orchard	16
Bear Creek	Regulated Stream	195.8	64% grassland 10% deciduous forest 7% mixed forest	48
Miles Creek	Regulated Stream	38.6	63% grassland 12% orchard 10% row crops	4
Owens Creek	Regulated Stream	41.2	57% grassland 12% deciduous forest 8% shrubland	Unavailable
Snake Slough	No information available			
Duck Slough	Regulated Stream	137.2	40% grassland 19% evergreen forest 13% deciduous forest	42
Deadman Creek	Stream	64.9	59% grassland 18% orchard 14% row crops	7
Dutchman Creek	Stream	62.9	68% grassland 18% orchard 9% row crops	7
Chowchilla River	Designated Floodway	294.9	35% grassland 24% evergreen forest 13% deciduous forest	130
Ash Slough	Designated Floodway	22.1	34% row crops 22% orchards 19% grassland	2.1
Berenda Slough	Designated Floodway	25.6	56% orchard 16% pasture 13% grassland	7

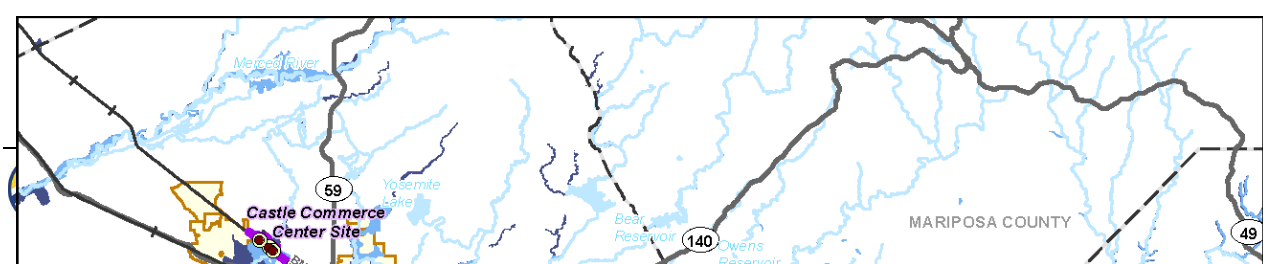
Named Natural Waterbody	Classification	Nominal Watershed Area (sq. mi.)	Top 3 Land Uses (%)	Mean Annual Flow Rate (modeled) (cfs)
Berenda Creek	Stream	37.7	58% grassland 32% orchard 9% pasture	4
Dry Creek	Regulated Stream	51.1	68% grassland 22% orchard 5% pasture	8
Schmidt Creek	Stream	No information available		
Fresno River	Designated Floodway	306.3	32% grassland 30% evergreen forest 10% deciduous forest	190
Cottonwood Creek	Stream	89.6	80% grassland 16% orchard 2% pasture	10
San Joaquin River	Designated Floodway	1,785.5	47% evergreen forest 28% shrubland 12% grassland	2,626
cfs = cubic feet per second				

3.4 Floodplains

Mapped Federal Emergency Management Agency (FEMA) floodplains are shown on Figure 3-3. Portions of each of the HST alternatives pass through many miles of shallow-flooding floodplain (see the *Hydraulics and Floodplain Technical Report* [Authority and FRA 2011a]). The effects of project stormwater runoff on mapped FEMA floodplains within the study area are expected to be negligible for several reasons:

1. The footprint of the HST Project is small relative to the overall size of the basins.
2. Where local HST facilities include impermeable surfaces, stormwater discharges would be attenuated through retention/infiltration and other means.
3. Because of the lag time in the natural watersheds, peak discharge from the HST right-of-way is not expected to coincide with periods of peak flooding.

Of more importance is ensuring that at-grade track segments within the floodplains, bridges, culverts and track support columns do not cause an unacceptable rise in design flood elevations due to hydraulic interference from obstruction of natural flowpaths. Hydraulic modeling will be performed to ensure that project features satisfy design restrictions on flood elevation rise and required freeboard to pass debris.



4.0 Regulatory Setting

This section summarizes stormwater regulations and guidelines applicable to the study area. Regulations pertaining to waterbody crossings and floodplain encroachments are summarized in Table 4-1. These regulations are described in more detail in the *Hydraulics and Floodplain Technical Report* (Authority and FRA 2011a).

Table 4-1
Summary of Other Applicable Federal and State Water Regulations

	Regulation	Summary
Federal	Clean Water Act (33 U.S.C. 1251 et seq.)	Establishes NPDES permit system to protect the water quality of the nation's surface waters; requires each state to identify water quality impaired waters and to carry out actions to restore designated stream uses; establishes Corps of Engineers review and permitting of project impacting wetlands.
Federal	Rivers and Harbors Act (33 U.S.C. 403 et seq. and 408)	Section 403 (more commonly known as Section 10) requires a Corps of Engineers permit for construction within navigable waterways; Section 408 requires Corps approval for modifications to any federal flood control facility.
Federal	National Flood Insurance Act (42 U.S.C. 4001 et seq.)	Requires mapping of floodplains and the establishment of criteria for floodplain development; provides for flood insurance to communities that comply with federal criteria.
Federal	Executive Order 11988	Requires that federally funded and/or permitted projects avoid floodplain impacts to the extent practical.
State	Porter Cologne Water Quality Act (Water Code 13000 et seq.)	Provides regional water quality control board responsibility for review and approval of waste discharges and the development and review of basin plans; establishes board responsibility for issuance of NPDES permits.
State	Central Valley Flood Protection Board (California Code of Regulations Title 23, Div. 1)	Provides coordination of flood control efforts of state and federal agencies within the Central Valley. Establishes a permit system for projects that encroach within designated floodways.
State	Central Valley Flood Protection Act (California Water Code 9600 et seq.)	Directs the California Department of Water Resources (DWR) and the Central Valley Flood Protection Board to collaborate to create a systemwide approach to flood protection in the Central Valley. The former is providing maps identifying the 200-year floodplain. The latter will work with local communities which are mandated by 2025 to amend their general plans to provide adequate flood protection.
State	Streambed Alteration Agreements	Requires notifying the California Department of Fish and Wildlife of any project disturbing a stream channel; the project proponent must comply with stipulations issued by the department for protection of the channel and stream habitat.

4.1 Regional Water Quality Control Board

The HST project is located within the jurisdiction of the Central Valley Regional Water Quality Control Board (RWQCB), also known as Region 5. Regulations for discharges within this area are

included in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (CRWQCBCVR 2009). Section 401 of USEPA's 2002 Clean Water Act is administered locally by the Central Valley RWQCB. This act stipulates that any action requiring a federal license or permit (see Section 4.4) and resulting in a discharge of pollutants into waters of the United States also requires water quality certification by the state. It is designed to ensure that the discharge will comply with applicable federal and state effluent limitations and water quality standards. Section 402(p) of the national Water Quality Protection Act of 1987 (33 United States Code [U.S.C.] 1251) requires that a Stormwater Pollution Prevention Plan (SWPPP) be prepared for construction projects that disturb more than 1 acre of land as part of the National Pollution Discharge Elimination System (NPDES). In California, the SWRCB is responsible for implementing this requirement through the Central Valley RWQCB.

4.2 State Water Resources Control Board

On July 1, 2010, the revised General Construction Stormwater Permit took effect, issued by the SWRCB. The requirements for this permit apply to any project that disturbs 1 acre or more of land. For a project to qualify under the general permit, a Notice of Intent must be filed with the SWRCB. An SWPPP must be prepared that details the erosion and sediment control measures and other pollution prevention measures that will be implemented at the project site. Individuals comprising the pollution prevention team must be identified. The SWPPP must contain a runoff monitoring plan and measures for inspecting, maintaining and upgrading, as necessary, the erosion control measures.

The General Construction Stormwater Permit deals with stormwater runoff leaving the project site and may also cover dewatering activities, although the individual regional water quality control boards may have special dewatering requirements. Numeric effluent limitations (NELs) for runoff leaving a project site are established for pH (maintain between 6.0 and 9.0 units) and turbidity (not to exceed 500 nephelometric turbidity units [NTU]). In addition, more stringent numeric action levels (NALs) are established for pH (greater than 6.5 and less than 8.5) and turbidity (less than 250 NTUs). If runoff monitoring indicates that a parameter exceeds an NAL, then corrective action must be taken on the project site to address the water quality problem.

Depending upon the location of a project, it is assigned one of three risk levels. Required erosion control and water quality protection measures increase with a higher risk level. The risk level is determined by two risk factors: sediment (erosion) risk and receiving water risk. Sediment risk is based upon the Universal Soil Loss Equation and a simplified method for calculating potential sediment loss from a construction site in tons of soil per year. Sediment risk is assigned as follows:

- Less than 15 tons/year: Low sediment risk (LSed)
- 15 to 75 tons/year: Medium sediment risk (MSed)
- Greater than 75 tons/year: High sediment risk (HSed)

Receiving water risk is classified as low or high. A high receiving water risk (HWat) is assigned if the natural waterbody to which project runoff discharges meets any of the following criteria:

- is on the Section 303d List of Impaired Waters for sediment, or
- has an assigned Total Maximum Daily Load (TMDL) for sediment, or
- has a designated beneficial use of coldwater habitat, fish spawning, or fish migration.

All other waterbodies are considered low risk (LWat). Various combinations of sediment risk and receiving water risk yield the following overall risk levels:

- Risk Level 1: LSed/LWat
- Risk Level 2: LSed/HWat, MSed/LWat, MSed/HWat, HSed/LWat
- Risk Level 3: HSed/HWat

Risk Level 1 sites are not subject to Numeric Effluent Standards or a Rain Event Action Plan (REAP; see below). Some of the site management requirements for Risk Level 1 sites are as follows:

- Practicing good housekeeping procedures for construction materials, waste, vehicle storage and maintenance, landscape materials
- Identifying potential pollutant sources
- Controlling non-stormwater discharges
- Implementing effective wind erosion controls
- Providing effective cover for inactive areas, finished slopes, and completed lots
- Establishing and maintaining perimeter control
- Stabilizing all construction entrances and exits
- Managing all site run-on and runoff
- Performing weekly site inspections
- Inspecting the site for all rain events equal to or greater than ½ inch
- Documenting how and when best management practice (BMP) maintenance and repairs were performed
- Retaining all inspection and monitoring reports
- Conducting quarterly non-stormwater discharge monitoring in addition to the inspections listed above
- Developing and implementing a construction site monitoring program (CSMP); the CSMP shall be a part of the SWPPP

Risk Level 2 sites are subject to NAL standards for pH turbidity. In addition to the Risk Level 1 requirements, the following apply to Risk Level 2 sites:

- REAPs required 48 hours prior to any likely precipitation event
- NAL for pH (6.5 to 8.5)
- NAL for turbidity (250 NTU)
- Formula-based linear sediment controls along toe, slope and face of slope, and at grade breaks of exposed slope
- Enhanced track-out control, including daily access road inspections

Risk Level 3 sites are subject to both NAL and NEL standards. In addition to both Risk Level 1 and 2 requirements, these following site management controls are required for Risk Level 3 assessed sites:

- Soil loss rate during each phase of construction is equivalent to or less than preconstruction level
- NEL for pH (6.0 to 9.0)
- NEL for turbidity (500 NTU)
- Receiving water sampling and monitoring required if NEL is violated
- Receiving water bio-assessment required if site is larger than 30 acres.

For Risk Level 2 or 3 sites, pH and turbidity must be monitored. Other non-visible pollutants such as pesticides or fertilizers must also be monitored if extensive use of these types of materials occurs at the

project site. A REAP must be prepared within 48 hours of an official forecast of 50% or greater probability of rain. The plan must detail the measures and materials on hand to assure adequate control of sedimentation or other pollutants at the project site. By September 1 of each year of construction, an annual summary of all monitoring results and corrective actions taken must be submitted via the Stormwater Multi-Application Reporting and Tracking System.

Following completion of a project, there are significant post-construction stormwater requirements for project sites lying outside of Phase I or Phase II communities (typically communities with a population greater than 10,000 that fall under the NPDES Municipal Stormwater Permit Program) that already possess stormwater permits. If a project site lies outside of a Phase I or Phase II community, then post-construction runoff flows must replicate preconstruction runoff volume up to the 85th percentile storm event. A continuous stormwater model, such as the Stormwater Management Model (SWMM) (USEPA 2010b) or the Hydrological Simulation Program–Fortran (HSPF) (Bicknell et al. 1997), may be developed to demonstrate that this condition is achieved. Alternatively, a spreadsheet method supplied by the SWRCB may be used to demonstrate compliance with this requirement. Unless it can be demonstrated that there are adequate green infrastructure measures to control runoff, some form of permanent stormwater facility, such as an infiltration or detention basin, could be required for larger project sites to comply with this post-construction stormwater requirement.

Note that local jurisdictions may have additional runoff control (detention) requirements that must also be met.

4.3 California Department of Transportation

Caltrans is not a direct reviewing agency for the HST Project; however, it has regulatory authority over those portions of the project that involve modifications to state highways, such as SR 99. The Authority has generally agreed to comply with Caltrans' requirements and templates, when practical. Caltrans HDM (Caltrans 2009a) contains detailed information for the design of highway and road stormwater systems. For those portions of the HST Project that involve altering or relocating state highways, the drainage design will need to follow Caltrans HDM.

The design storm used for freeways and conventional highways with speeds over 45 miles per hour (mph) is the 25-year storm event. For other conventional highways and for freeway ramps and frontage roads, the design storm is the 10-year storm event (Caltrans 2009a, Table 831.3). A 50-year storm event should be used for pump stations intended to pump runoff from depressed sections. Sections of the HDM pertinent to drainage design include the following:

- Section 816. Runoff
- Section 819. Estimating Discharge
- Section 822. Debris Control
- Sections 825 to 829. Culverts
- Section 830. Roadway Drainage
- Section 882. Infiltration systems
- Section 890. Stormwater Management

The PPDG (Caltrans 2010) provides guidance on incorporating BMPs into highway projects. Caltrans must meet the stormwater requirements spelled out in the statewide construction general permit issued by the SWRCB (see Section 4.1). The PPDG ensures that this happens. It presents the process by which stormwater and water quality issues are addressed and integrated into Caltrans' projects. The PPDG identifies approved BMPs that fall into four categories: design BMPs (permanent stabilization and conveyance features), treatment BMPs (permanent facilities for stormwater treatment and/or detention), construction BMPs (temporary measures to control erosion and other pollutants generated at a project site during construction), and maintenance BMPs (litter pickup, street sweeping, BMP cleaning, etc.).

Water quality requirements for a project are identified from Section 303d-listed streams and TMDL plans within that project's study area. These requirements are also identified in the appropriate basin plan

which, for the HST project, is the *Water Quality Control Plan for the Central Valley Region* (Central Valley RWQCB 2009). In addition, water quality requirements for a project are identified through discussions with the appropriate regional water quality control board early in the project.

A Targeted Design Constituent (TDC) is a pollutant that has been identified by Caltrans to be discharging with a load or concentration that commonly exceeds allowable standards and which is considered treatable by currently available Caltrans-approved treatment BMPs. The TDC approach is the Caltrans' statewide design guidance for addressing primary pollutants of concern. TDCs are phosphorus, nitrogen, total copper, dissolved copper, total lead, dissolved lead, total zinc, dissolved zinc, sediments, and general metals (unspecified metals). Caltrans-approved BMPs include biofiltration, infiltration, detention, traction sand traps, dry weather flow diversion, gross solids (litter) removal devices, wet basins (treatment wetlands), media filters, and a multi-chamber treatment train. There is also a process for allowing non-approved BMPs to be incorporated into individual projects, where justified.

Caltrans-approved BMPs can be sized by calculating either the water quality volume (WQV) or the water quality flow (WQF), whichever is appropriate. The WQV is that volume sufficient to capture 85% of the annual runoff from the project site (note that the regional water quality board should be consulted for a possible region-specific WQV.) The region-specific WQF for the HST study area is the runoff flow generated from 0.16 inch rainfall per hour (Caltrans 2010) using the Rational Method (Q = CIA).

Sustainable Infrastructure [also known as Green Infrastructure or low-impact development (LID)] is encouraged in the PPDG (Caltrans 2009a), as provided for below:

> "Throughout the design process, the PE [Project Engineer] may incorporate sustainable infrastructure. The term sustainable infrastructure means designing streets, highways, buildings, and other facilities with an emphasis toward resource conservation over the life of the project through selection of materials and implementation of practices that reduce impacts on the general environment with the emphasis of using recycled products, managing eco-systems, reducing energy, increasing the quality of stormwater runoff, and maximizing overall societal benefits. Incorporation of sustainable infrastructure features that benefit stormwater or receiving water quality can be considered stormwater BMPs; these features are typically known as low impact development (LID). LID is a stormwater management strategy aimed at maintaining or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives. LID employs a variety of natural and engineered features that reduce the rate of runoff, filter pollutants out of runoff, and facilitate the infiltration of water into the ground."

Treatment BMPs and construction site BMPs are incorporated into a project during the Project Approval/Environmental Document process. A Stormwater Data Report is prepared and a series of checklists are filled out that guide BMP selection. A Stormwater Data Report for the HST project is being prepared under separate cover. Engineering studies on the BMPs will be completed during the next phase of the design—the Plans, Specifications and Estimates Phase. In addition, a water pollution control plan may be prepared showing the locations of appropriate construction site BMPs.

Appendix B of the PPDR describes the approved treatment BMPs, and Appendix C of the PPDR describes the approved construction site BMPs.

4.4 Local Stormwater Requirements

The cities and counties within the study area have regulations and manuals governing stormwater management for projects constructed within their respective jurisdictions. These include the following:

- Counties of Merced, Madera, and Fresno
- Cities of Atwater, Merced, Chowchilla, Madera, and Fresno
- Fresno Metropolitan Flood Control District, which operates in the City of Fresno and Fresno County.

No contacts were made with local jurisdictions during the development of this SWMP. Internet searches yielded manuals from several of the jurisdictions that appeared to be more than 10 years old. As shown in Section 4.2, stormwater requirements have changed significantly at the state level and it is expected that the requirements of the local jurisdictions will need to be modified in the near future to comply with state requirements. It is recommended that public works department officials from each of the jurisdictions be contacted and interviewed as soon as possible for the purpose of acquiring up-to-date information on local stormwater regulations and manuals.

5.0 Runoff Interception and Conveyance Strategy

5.1 Overall Concept

Major drainage design concepts for the HST Project are described in this section. Where feasible and practical, the drainage design will do the following:

- Maintain existing drainage flow patterns.
- Disperse onsite runoff to encourage local infiltration.
- Incorporate existing drainage systems.
- Improve existing drainage capacity if the HST Project exacerbates existing drainage problems or flooding at a location where the existing system is known to be undersized.
- Provide offline treatment BMPs to treat runoff from pollution-generating impervious surfaces to the maximum extent practicable before discharging to receiving waters in order to meet water quality objectives and water quality standards set forth by the Central Valley RWQCB.

The following sections describe existing and proposed drainage conditions along the HST alignment for both onsite and offsite systems.

5.2 Onsite Runoff

5.2.1 Existing Onsite Drainage Conditions

UPRR/SR 99 and BNSF Transportation Corridors: Existing onsite drainage along the UPRR/SR 99 and BNSF transportation corridors varies by location. Along the rural segments, existing drainage systems consist primarily of swales, surface ditches, and culverts that drain directly to waterbodies without engineered detention or treatment. During the irrigation season, runoff is typically dominated by return flows from irrigation.

In the urban segments, typified by Merced to the north and Fresno to the south, city streets often parallel, intersect, or dead-end at the linear UPRR/SR 99 alignments. These impermeable features include storm drains and inlets that outlet to either stormwater retention ponds for infiltration, or longitudinal surface ditches that drain directly to waterbodies without stormwater treatment.

Within the study area, virtually all natural waterbodies and various irrigation canals/ditches are used to convey irrigation water and stormwater. In most cases—based on prior agreements with the Merced Irrigation District, Madera Irrigation District, and Fresno Irrigation District—excess floodwaters are pumped from retention/detention ponds to natural and manmade waterbodies when retention capacities are exceeded and conveyance capacity remains.

UPRR-BNSF Southern Link: Relatively few existing drainage systems will be affected by the BNSF alignment where it traverses between the UPPR/SR 99 and BNSF transportation corridors on the south end, south of Chowchilla (see Figure 2-1). The HST Project would primarily cross open fields, farmland, and country roads across relatively flat terrain. Existing drainage systems consist primarily of small ditches and culverts.

UPRR-BNSF Northern Link: Where the BNSF alignment traverses between the UPPR/SR 99 and BNSF transportation corridors on the north end (north of Chowchilla; see Figure 2-1), the HST Project would parallel existing rural roadways and transition into suburban developments. A number of natural waterways are crossed in this segment, some with levees. Existing drainage conditions consist of a mix of those indicated above for rural and urban segments.

5.2.2 Proposed Onsite Drainage Conditions

At-Grade Track Segments: The “at-grade” track would rest on ballast fill. Depending on local topographic slopes, the ballast may be placed in the form of an embankment, typically about 4 to 10 feet high. Rainfall would percolate through the rail ballast but would be unlikely to infiltrate readily into the underlying ground due to compaction and would likely flow laterally out from the ballast. Emphasis will be placed upon onsite retention of runoff by using low impact development measures. If the soils in the adjacent right-of-way are Hydrologic Soil Group (HSG) A or B soils, the runoff would likely infiltrate onsite. For slower infiltrating soils (HSG C and D), composted-amended soils in the right-of-way would encourage infiltration and reduce or eliminate runoff. For maximum effectiveness, an asymmetric placement of the tracks near the upgradient side of the right-of-way should be considered to maximize the area for runoff dispersal and onsite infiltration, as depicted in Figure 5-1. For highly developed urban areas, areas with poorly draining soils, and known drainage problem areas, conventional stormwater ditches leading to established discharge locations would likely be required.

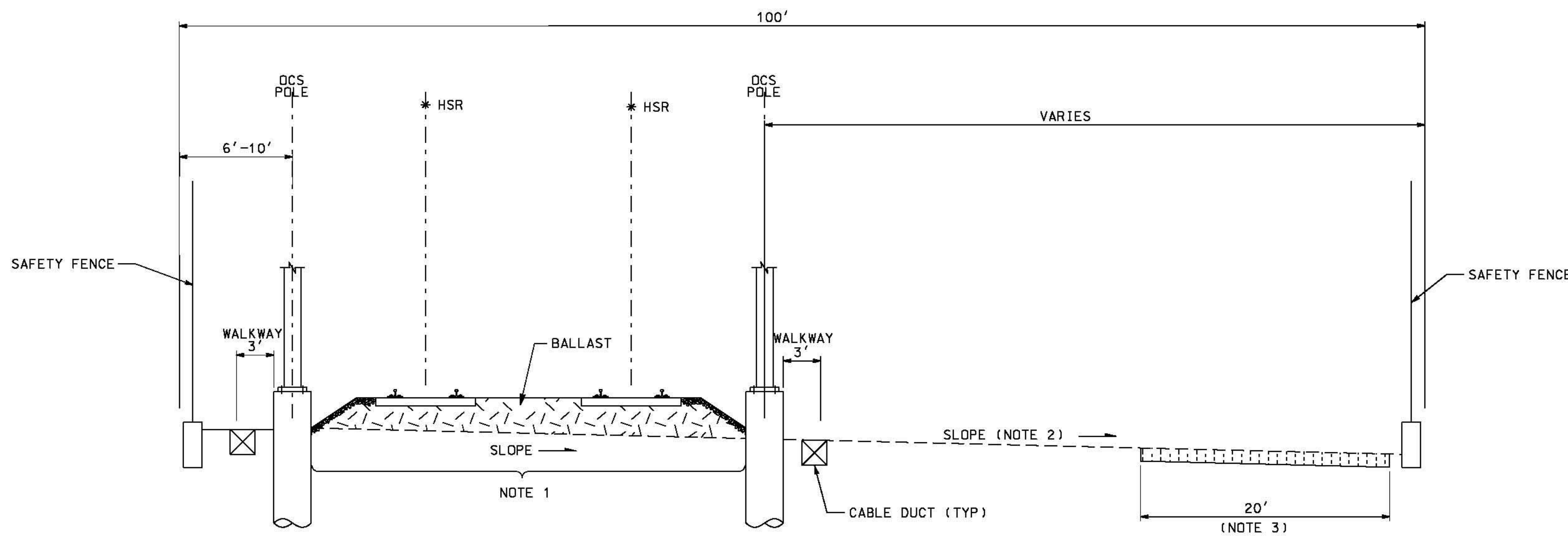
Elevated Track Segments: The elevated track would be supported by slabs, beams, and columns constructed from reinforced concrete and steel. The elevated track, characteristic of so much of the length of this project, would offer some special opportunities for managing stormwater using low impact development measures. Table 5-1 shows the miles of elevated track by alternative. Elevated track would account for around 50-70 miles of individual track for the UPRR/SR 99 Alternative, around 30 miles of the BNSF Alternative, and 13 miles of the Hybrid Alternative. The percentage of elevated track ranges from a low of 9 percent for the Hybrid Alternative to a high of 41 percent for the UPRR/SR99 (East Chowchilla-Avenue 24 Wye) Alternative.

Table 5-1
Elevated Track*

Alternative	Total Track (miles)	Elevated Track (miles)	% Elevated Route
UPRR/SR 99	177-180	51-73	29-41%
BNSF	190-198	27-34	14-17%
Hybrid	138	13	9%
*Quantified as individual tracks extending in both directions			

Where the elevated guideway crosses unpaved ground, runoff from the impervious track supports could be dispersed to native ground beneath the track for infiltration; this could be accomplished through several methods. Runoff could be allowed to sheet-flow directly off the edges of the elevated guideway and disperse onto the ground, as depicted in Figure 5-2. This method has been successfully applied on the recently constructed Sound Transit Light Rail project in Seattle, Washington (Luther 2010). The use of this method would be more likely in less densely populated or rural areas. As an alternative, raised curbs at the outer edges of the guideway could be used to collect runoff where it can be conveyed to the ground at each column for dispersal or underground retention and infiltration, as depicted in Figure 5-3. Either of these approaches would largely eliminate the need for offsite ditches or pipes to convey local runoff, encouraging local retention instead. A program of adaptive monitoring of local drainage conditions should be carried out for several years following construction in order to identify and correct any residual drainage problems that might develop along the HST right-of-way.

Where the elevated guideway passes over developed urban corridors with existing impervious surfaces, rainwater would be collected via inlets and conveyed down support columns to the existing storm drainage system. An analysis of the receiving drainage system must be carried out to assure there is adequate capacity. Where sufficient capacity to accommodate project runoff is found



NOTES:

1. BALLAST BASE SLOPED A MINIMUM OF 1%.
2. MAXIMUM TRANSVERSE SLOPE: 5%
3. 12" DEPTH OF AMENDED SOIL SEEDED WITH NATIVE GRASS MIX. NOT NEEDED FOR HYDROLOGIC SOIL GROUP A OR B SOILS.

AECOM CH2MHILL

CALIFORNIA HIGH SPEED RAIL AUTHORITY
FLY CALIFORNIA
Without ever leaving the ground.

CONTRACT NO. C-0-000
SCALE 1"=5'

Figure 5-1
Typical At-Grade Section Promoting Onsite Retention of Runoff

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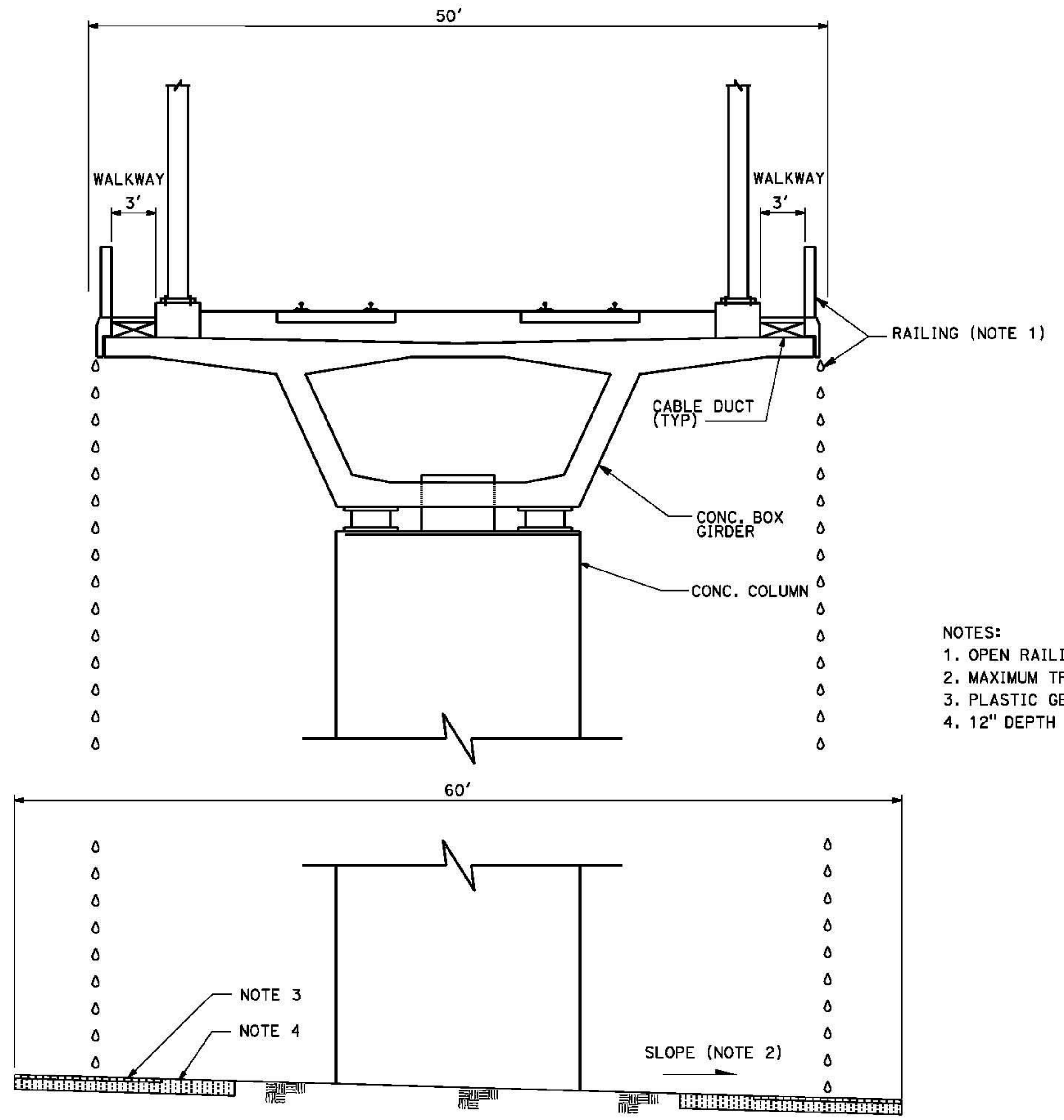

NOTES:
1. OPEN RAILING THAT ALLOWS RUNOFF TO EVENLY SHEET FLOW OFF OF THE GUIDEWAY.
2. MAXIMUM TRANSVERSE SLOPE: 5%
3. PLASTIC GEOGRID LAID 5-FEET TO EITHER SIDE OF DRIP LINE.
4. 12" DEPTH OF AMENDED SOIL SEEDED WITH NATIVE GRASS MIX.

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

AECOM CH2MHILL

CALIFORNIA HIGH SPEED RAIL AUTHORITY
FLY CALIFORNIA
Without ever leaving the ground.

Figure 2
Typical Elevated Guideway Section with Dispersed Runoff Falling Directly to the Ground

CONTRACT NO. C-0-000
DRAWING NO.
SCALE 1"= 5'
SHEET NO.

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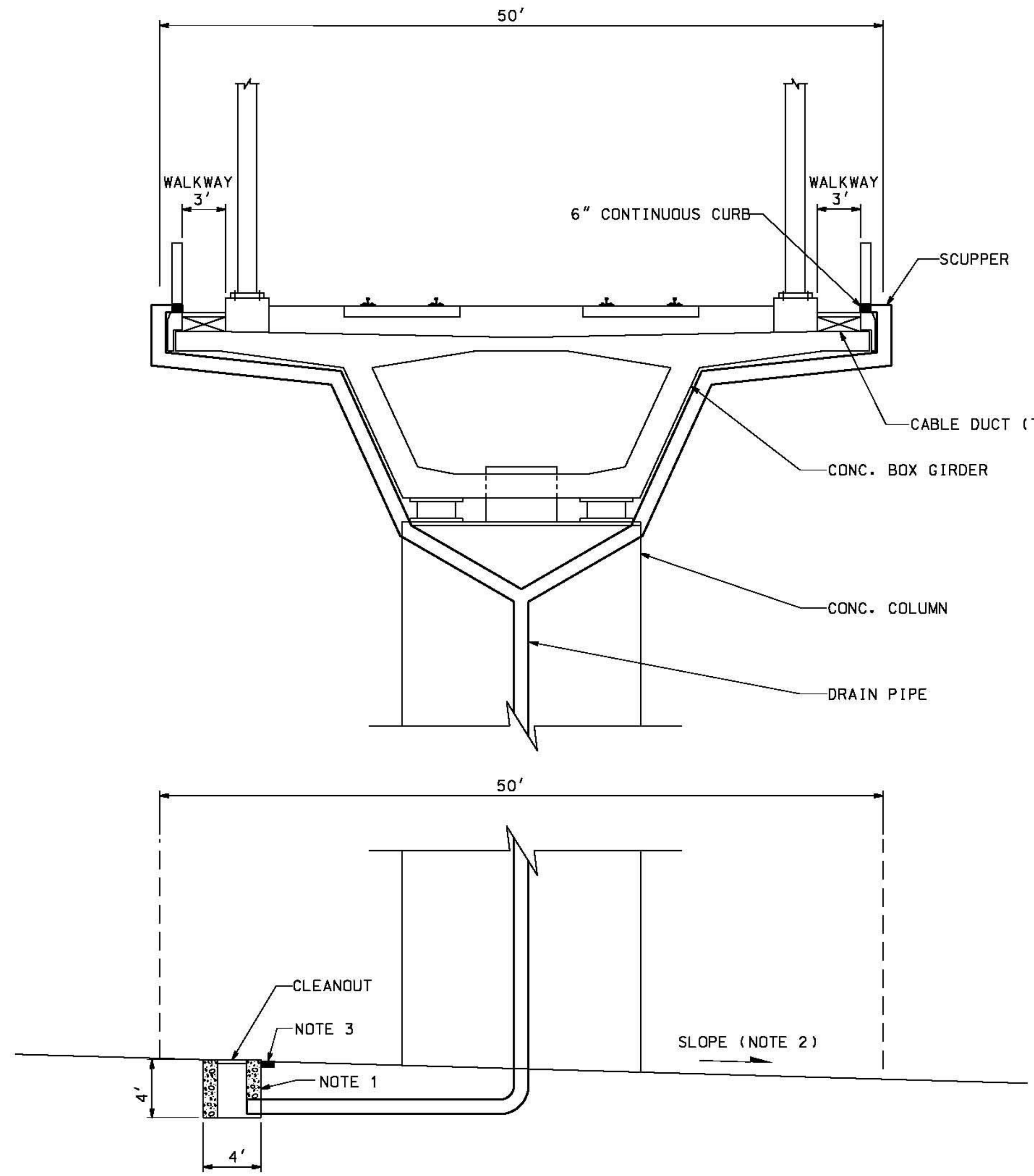

NOTES:
1. GRAVEL-FILLED INFILTRATION AND FLOW SPREADER TRENCH.
2. MAXIMUM TRANSVERSE SLOPE: 5%
3. 6"x6" CONCRETE LEVELER.

REV	DATE	BY	CHK	APP	DESCRIPTION	DESIGNED BY / DRAWN BY / CHECKED BY / IN CHARGE / DATE

AECOM CH2MHILL

CALIFORNIA HIGH SPEED RAIL AUTHORITY
FLY CALIFORNIA
Without ever leaving the ground.

Figure 5-3
Typical Elevated Guideway Section with Downspouts and Infiltration Trench

CONTRACT NO. C-0-000
DRAWING NO.
SCALE 1"=5'
SHEET NO.

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to be lacking, additional capacity would need to be added. Alternatively, onsite retention/detention could be pursued if adequate right-of-way exists.

Passenger Stations: The Merced and Fresno Section passenger stations would include significant impermeable surfaces in the forms of roofs, platforms, ramps, stairs, buildings, parking areas, and other hard structures. Some or all of these may be classified as pollutant-generating surfaces, requiring water quality BMPs and quantity detention prior to release to existing stormwater systems. As design progresses, the new stormwater system may include such features as inlets, grated catch basins, storm drains, flow splitters, detention/infiltration basins, and energy dissipaters. It may also include treatment BMPs and LID approaches such as dispersal, infiltration trenches, filter strips, biofiltration swales, and permeable pavement.

Heavy Maintenance Facilities: An HMF would cover a large area, about 150 acres. Most of that area would consist of impermeable surfaces that would produce large amounts of runoff. Several large parking areas plus several outdoor maintenance activities would produce polluted runoff that would require water quality treatment. Stormwater treatment at the HMF site is discussed in Section 6.2.1. An extensive system of pipes and ditches would be required to route the HMF runoff to treatment BMPs (where required) and to one or more stormwater holding areas. Until treated, runoff requiring treatment should be kept segregated from the much larger areas where no treatment would be necessary in order to minimize that amount of stormwater requiring treatment.

Given the large amount of onsite stormwater generated at the HMF, onsite detention will be required to protect the receiving stream. If soil conditions are found to be supportive, all or most of the stormwater may be infiltrated onsite. If this is the case, the water quality treatment requirements may be greatly reduced to perhaps oil/water separation and emergency containment provision for high-use areas. If onsite infiltration cannot be accomplished, then stormwater detention must be provided. With the exception of the Castle Commerce Center site, all of the proposed sites have adequate area for either an infiltration pond or a detention pond. Several of the sites have very little topographic relief. As a result, stormwater pumping could be required.

State Highways: The HST Project would result in the relocation of more than 2 miles of SR 99 within the city of Fresno. The highway would be relocated approximately 80 feet to the west to allow room for elevated tracks. The HST Project would maintain six through lanes and add one auxiliary lane in each direction. The Clinton Avenue Bridge would be replaced and the Ashlan Avenue interchange would be reconstructed. An existing highway drainage system provides stormwater collection and the runoff is generally conveyed to the city's drainage system, most of which flows to infiltration basins operated by the Fresno Metropolitan Flood Control District.

Up to an additional 29 new or modified overcrossings or interchanges may be constructed at other locations (mostly along SR 99) between Merced and Fresno. The drainage systems would need to be modified or replaced and would generally drain to offsite drainage ditches.

Modified Intersections: Because of safety concerns surrounding the high speed of the HST, there will be no at-grade crossings of the HST tracks. This will require modification of existing intersections where the HST is at grade or in spatial conflict with existing overpasses. Runoff from the new and replaced roadway pavement would require stormwater treatment and, in some cases, flow attenuation to meet current stormwater management requirements. Local flow paths and discharge points will not be modified substantially. Discharges from Caltrans right-of-way will be subject to Caltrans NPDES requirements.

5.3 Offsite Runoff

5.3.1 Existing Offsite Drainage Conditions

Offsite drainage consists of overland sheet flow; and concentrated flow in swales and ditches, irrigation ditches and canals (many confined by elevated embankments/levees), and natural channels (some of which include levees, embankments or diversions). (See Section 3.0 for a discussion of the hydrologic setting, stream channels, and irrigation networks in the study area.) Existing features that are intended to convey or store stormwater include natural and constructed channels; irrigation-canal headworks, outfalls, diversions, and laterals; bridges, culverts, pipes, and siphons; and stormwater infrastructure such as curbs, gutters, inlets, storm drains, stormwater retention/detention ponds, and pumping systems.

At most locations in the Merced to Fresno Section, existing streets are laid out in a north-south/east-west grid pattern. The UPPR/SR 99 and BNSF transportation corridors cut across this pattern at a roughly 45-degree angle, running northwest and southeast. To accommodate these angled railroad and state highway embankments, portions of the adjacent road network have been similarly angled to parallel the railroad and highway as frontage roads or approach them orthogonally as intersections or dead ends. Examples of areas that have been angled to match the orientation of the UPRR/SR 99 corridor are most of Merced and Chowchilla, portions of Fairmead, Berenda, Downtown Madera; Fresno between SR 99 and North Golden State Boulevard, which serves as a frontage road on the northeastern side; and isolated (typically unpaved) frontage roads in rural farmland areas. Additionally, portions of Le Grand, Kismet, Madera, Storey, and Trigo follow the orientation of the BNSF route; and Santa Fe Avenue/Drive parallels the BNSF route northwest of Sharon. At the northern crossover between the BNSF and UPRR/SR 99 corridors, the BNSF Alternative would generally run east-west parallel to East Mariposa Way or East Mission Avenue.

As shown on Figure 2-1, the HST alternatives would lie roughly orthogonal to the major natural channels in the Merced to Fresno Section. This northeast-to-southwest or east-to-west orientation of natural channels generally extends to unnamed swales that cross fields and pass through existing culverts—especially at the existing BNSF railroad embankment.

5.3.2 Proposed Offsite Drainage Conditions

Runoff generated upgradient (uphill) of the HST alignment would be allowed to pass the intercepting sections of project embankment, retained fill, or retained cut. Specific design requirements for waterbody crossings are provided in the *Hydraulics and Floodplain Technical Report* (Authority and FRA 2011a). Also, the Authority has agreed to follow the Caltrans HDM, with few exceptions, and has summarized design guidelines in Technical Memorandum (TM) 2.6.5 *Hydraulics and Hydrology Design Guidelines* (Parsons-Brinckerhoff 2010).

Where the HST would be adjacent to existing transportation corridors on the northeastern (upgradient) side, the existing stormwater collection and conveyance systems typically consist of ditches in rural areas and ditches or inlets and storm drains in urban areas. Where the HST would be located on the southwestern (downgradient) side of existing highway or railroad embankments, the existing conveyance systems pass flow through those embankments via culverts, bridges, or irrigation conduits to pipes, ditches, canals, or channels constructed with a similar conveyance capacity on the downstream side of the embankments. The at-grade portions of the HST would generally displace all or portions of these existing collection and conveyance features, and the features would need to be extended and/or relocated to the outer edge of the HST right-of-way.

In general, water passage through intercepting at-grade track segments would be provided for minor swales and ditches via circular culverts sized to match or exceed existing culvert pipe capacity. Water passage for minor natural channels would be provided via box culverts with a capacity sufficient to match or exceed existing culvert capacity. For larger natural channels, bridges would be provided with a minimum of 3 feet of vertical clearance above the design-flow capacity (generally

the 100-year or 200-year flood) to allow debris to freely pass downstream. Net water surface rise caused by the new crossings would be less than either 1 foot (consistent with FEMA floodplain restrictions) or 0.1 foot (consistent with state-federal flood control projects), depending on the governing jurisdiction of each crossing. An exception to this would be an encroachment into a designated FEMA floodway. In this case, the project must demonstrate that the encroachment would result in no increase (also known as zero rise) in the 100-year flood elevation.

Based on preliminary input received from the irrigation districts, most irrigation canals would be passed under the HST via a pipe, with adequate pipe extension beyond the right-of-way to provide for turnaround vehicle access to both sides of the canal. In general, canals with design flows less than about 100 cubic feet per second (cfs) would be piped, and canals with design flows of about 100 cfs or more would be passed through one or more box culverts or under a bridge that provides adequate clearance for maintenance and repairs.

Where impervious surfaces generate stormwater that cannot be readily discharged to stormwater infrastructure or a waterbody within or adjacent to the HST right-of-way, new conveyance pipelines may be required offsite to convey stormwater to a suitable drainage location.

5.3.3 Offsite Drainage Design Considerations

Among other things, design considerations for passing offsite runoff that crosses the HST right-of-way should include design flow rate, required freeboard/clearance, backwater depths and distances, energy dissipation and erosion control at outlets, potential bulking factors for sediment discharge, and possibly hydromodification.

5.4 Design Flood Frequencies

Stormwater features that impact streams, large channels, and similar features draining large areas should comply with the design flood frequencies summarized in Table 3-1 of TM 2.6.5 *Hydraulics and Hydrology Design Guidelines* (Parsons-Brinckerhoff 2010). Relevant values current as of August 2010 are provided in Table 5-2. Note that these criteria may be revised at the 30% design level.

Table 5-2
Design Frequencies for the California High-Speed Train Project

Storm Facility	Rural	Urban
Drainage facilities crossing the HST track (i.e., culverts)	2% (50-year)	1% (100-year)
Drainage facilities not crossing the HST track (i.e., parking lots, station drainage facilities)	10% (10-year)	2% (50-year)
Ditches/storm drainage systems adjacent to the HST track	4% (25-year)	2% (50-year)
Freeways, highways, local streets, roadway drainage, etc.	Refer to Caltrans HDM Chapter 830, Topic 831	Refer to Caltrans HDM Chapter 830, Topic 831
Drainage systems crossing under bridge structure and on the right-of-way	2% (50-year)	1% (100-year)
Critical facilities (electrical, vents, communication buildings, etc.)	Min. 1% (100-year)	Min. 1% (100-year)

5.4.1 Hydrologic Analysis

According to TM 2.6.5 *Hydraulics and Hydrology Design Guidelines* (Parsons-Brinckerhoff 2010), hydraulic design of storm conveyance facilities shall generally conform with Metrolink's *Design Criteria Manual* (Metrolink 2003) for optimum combination of efficiency and economy.

According to TM 2.6.5 *Hydraulics and Hydrology Design Guidelines* (Parsons-Brinckerhoff 2010), design discharge for catchment areas of less than 0.5 square mile shall generally be determined using the Rational Method:

$$Q = C * I * A$$

Where:

Q = Design discharge (cfs)

C = Runoff coefficient (unitless)

I = Average rainfall intensity (inches/hr) for the selected rainfall frequency for a duration equal to the time of concentration.

A = Catchment area (acres)

Methods specified by the governing local agency should be used for larger catchments and for project locations requiring flow attenuation. This may include continuous flow modeling. See Caltrans' HDM, Topic 819 for methods to calculate HST design discharge. Where HST drainage facilities would impact or connect to existing facilities, the local owning agency's criteria should be used. The Caltrans' HDM approves the use of the following software (see Topic 808):

- <u>Hydrology</u>: TR-55, HEC-1/HEC-HMS, WMS, Caltrans IDF, Hydraflow Hydrographs
- <u>Hydraulics</u>: HY-22, HEC-1/HEC/HMS, HY-8, HEC-RAS, FESWMS, HDS No5: CD, WMS, Hydraflow Storm Sewers, Hydraflow Hydragraphs

6.0 Water Pollution Control Strategy

6.1 Construction Phase

Erosion and sediment control practices during construction are vital for the protection of water quality. This section discusses applicable BMPs and construction monitoring.

6.1.1 Best Management Practices

A state General Construction Permit (NPDES Permit for Storm Water Discharges Associated with Construction Activity) for discharge of stormwater from a construction activity must be acquired prior to the start of project construction. In order to obtain coverage under the General Construction Permit, a Notice of Intent must be filed with the SWRCB. An SWPPP also must be prepared once final design documents are available. The selection of construction BMPs are determined as part of the development for the SWPPP. However, the following general construction guidelines should be considered when selecting BMPs for the HST Project:

- Source identification and control (through covering and containing) of potential pollutants
- Erosion control techniques for temporary, permanent, and wind conditions (types of erosion control to be considered include rolled erosion control products and hydraulically applied mulches)
- Sediment control techniques with the specific objective of maintaining sediment loads consistent with preconstruction levels (types of sediment control BMPs to be considered include fiber rolls, silt fence, drainage inlet protection and sediment traps and basins)
- Control of non-stormwater through elimination of sources.

In addition, specific BMPs will be identified for work done above and adjacent to waterways, including such items as:

- Minimizing demolition and construction activities within or over stream channels during the wet season
- Using non-shattering demolition methods that would normally scatter debris
- Securing all materials adjacent to streams to prevent discharges into receiving waters via wind
- Using attachments on equipment to catch debris from small demolition operations
- Stockpiling accumulated debris and waste generated from demolition away from streams
- Isolating work areas within streams from flow using sheet piling, k-rails, or other methods of isolation
- Pumping stream flow within pipes around the construction area
- Using drip pans during equipment operation, maintenance, cleaning, fueling, and storage for spill prevention
- Keeping equipment used in streams leak-free
- Directing water from concrete curing and finishing operations away from inlets and water courses to collection areas for dewatering

The SWPPP will also include a stormwater runoff sampling plan to ensure that BMPs are functioning effectively during construction. When construction is complete and after a uniform vegetative cover

(with at least 70% coverage) has been established, a Notice of Termination must be filed with the SWRCB.

There are many practices that can be implemented to avoid water quality impacts by managing potential pollutants at their source, and by effectively providing and managing sediment control and soil stabilization BMPs. Source control measures, sediment control BMPs, and soil stabilization BMPs to the HST Project are listed below. Detailed descriptions of these practices can be found in the PPDG (Caltrans 2010).

Source Control

- NS-1: Water Conservation Practices
- NS-2: Dewatering Operations
- NS-3: Paving and Grinding Operations
- NS-4: Temporary Stream Crossing
- NS-5: Clean Water Diversion
- NS-8: Vehicle and Equipment Cleaning
- NS-9: Vehicle and Equipment Fueling
- NS-10: Vehicle and Equipment Maintenance
- NS-11: Pile Driving Operations
- NS-12: Concrete Curing
- NS-13: Material and Equipment Use over Water
- NS-14: Concrete Finishing
- NS-15: Structure Demolition/Removal over Water

Sediment Control Practices/BMPs

- SC-1: Silt Fence
- SC-2: Sediment/Desilting Basin
- SC-3: Sediment Trap
- SC-4: Check Dam
- SC-5: Fiber Rolls
- SC-6: Gravel Bag Berm
- SC-7: Street Sweeping and Vacuuming
- SC-8: Sand Bag Barrier
- SC-9: Straw Bale Barrier
- SC-10: Storm Drain Inlet Protection
- TC-1: Stabilized Construction Entrance
- TC-2: Stabilized Construction Roadway
- TC-3: Entrance/Outlet Tire Wash
- WE-1: Wind Erosion Control

Soil Stabilization BMPs

- SS-1: Scheduling
- SS-2: Preservation and Existing Vegetation
- SS-3: Hydraulic Mulch
- SS-4: Hydro Seeding
- SS-5: Soil Binders
- SS-6: Straw Mulch
- SS-7: Geotextiles, Mats, Plastic Covers, and Erosion Control Blankets
- SS-8: Wood Mulching
- SS-9: Earth Dikes/Drainage Swales and Ditches
- SS-10: Outlet Protection/Velocity Dissipation Devices
- SS-11: Slope Drains
- SS-12: Streambank Stabilization

Proper materials pollution control and waste management practices are another effective means of source control. Applicable practices include the following:

Waste Management and Materials Pollution Control

- WM-1: Material Delivery and Storage
- WM-2: Material Use
- WM-3: Stockpile Management
- WM-4: Spill Prevention and Control
- WM-5: Solid Waste Management
- WM-6: Hazardous Waste Management
- WM-7: Contaminated Soil Management
- WM-8: Concrete Waste Management
- WM-9: Sanitary/Septic Waste Management
- WM-10: Liquid Waste Management

Source Identification and Control of Potential Pollutants

A thorough identification of potential sources of water pollution should be made for all construction activities. Measures to control potential pollution sources include the following:

- Covering and containing pollutants such as covering petroleum products, chemicals, and fertilizers
- Covering stockpiles when not in active use
- Inspecting all vehicles, equipment, and petroleum product storage/dispensing areas regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills
- Incorporating secondary containment for onsite fueling tanks and petroleum product storage containers
- Using spill prevention measures, such as drip pans, when conducting fueling, maintenance, and repair of vehicles or equipment. These activities should occur no closer than 100 feet from any stream, ditch, or other stormwater conveyance
- Using temporary plastic sheeting beneath and, if raining, over a vehicle when performing emergency repairs onsite
- Cleaning contaminated surfaces immediately, and removing contaminated soils

Erosion Controls

There are many applicable standard BMPs available. Some BMPs that should be considered include the following:

- Using rolled erosion control products in conjunction with hydroseeding and mulching along steeper slopes, particularly next to river and creek banks
- Stabilizing construction entrances
- Establishing and maintaining perimeter control BMPs, such as high visibility fences and silt fences
- Using street sweepers to remove dirt tracked from construction sites onto the roadway

- Installing catch basin filters for existing catch basins that receive construction runoff
- Installing check dams

Controlling High pH Levels

Each of the HST alternatives would have long sections of elevated rail guideway. Large volumes of concrete would be poured to construct the guideway columns. Stormwater and groundwater coming in contact with freshly poured concrete would be subjected to very high pH levels. Construction stormwater runoff and dewatering with high pH levels must be isolated and treated in mobile detention tanks, such as Baker tanks, or temporary sediment ponds with dry ice or carbon dioxide sparging.

6.1.2 Preliminary Risk Level Assessment

The degree of monitoring and erosion control required during construction is determined by the risk level posed by the construction site (refer to Section 4.2 for a discussion of risk level). A preliminary analysis of risk level was carried out for the study area. Those portions of the study area that flow directly to the San Joaquin River, above the Mendota Pool (located about 20 miles downstream from the river crossing of SR 99), fall within a Risk Level 2 area because this portion of the river supports coldwater fish spawning and migration. The remainder of the project area falls under Risk Level 1. The details of the risk level determination are provided in Appendix A.

Risk Level 1 project sites are not subject to NAL Standards, so a REAP would not be required. Site management requirements for Risk Level 1 include the following:

- Practicing good housekeeping procedures with regards to construction materials, waste management, vehicle storage and maintenance, and landscape materials
- Identifying potential pollutant sources
- Controlling and managing non-stormwater discharges
- Implementing effective erosion control
- Providing effective sediment controls
- Effectively manage run-on and runoff that discharges off the site
- Establishing and maintaining perimeter control
- Conducting inspection, maintenance, and repair by a Qualified SWPPP Practitioner (QSP)

Key requirements for Risk Level 1 projects with respect to managing all site run-on and runoff are as listed below:

1. Prepare a CSMP that includes site-specific monitoring procedures and instructions as an appendix or a separate SWPPP chapter.

Perform visual observation of the site 48 hours prior to each qualifying rain event.[1]

2. Perform visual inspections within two business days of qualifying rain events that produce precipitation of ½ inch or more.

[1] In the event of an obvious failure that results in the discharge of pollutants to surface waters, runoff samples must be collected and analyzed.

3. Identify during the inspections whether BMPs were adequately designed, implemented, and effective. Also, identify additional BMPs and revise SWPPP accordingly.
4. Maintain onsite records of all visual observations, personnel performing the observations, dates, weather conditions, locations observed, and corrective actions taken in response to the observations.
5. Document how and when BMP maintenance and repair were performed.
6. Retain all inspection reports.

As stated above, the southern portion of the study area, which drains to the San Joaquin River above the Mendota Pool, will be subject to Risk Level 2 requirements. In addition, Risk Level 2 requirements should be implemented wherever the HST Project impacts environmentally sensitive areas. The HST tracks would cross many environmentally sensitive areas, including wetlands, vernal pool areas, and river and creek crossings. These areas are particularly sensitive to construction site runoff. Therefore, Risk Level 2 measures will be implemented for all construction work that occurs inside the boundaries of, or within 100 feet of the boundary, of all environmentally sensitive areas. Figures 6-1a through 6-1d show steam crossings, wetlands, and vernal pool areas where Risk Level 2 measures will be applicable.

All of the HST alternatives pass through critical habitat areas such as wetlands and vernal pools between Ash Slough and Owens Creek. The BNSF Alternative near the town of Le Grand passes through multiple wetlands as well as large areas designated as vernal pools (see Figures 6-1a through 6-1d). In all cases, sensitive areas must be delineated and construction runoff must be controlled and treated before being discharged to wetlands or vernal pools to protect critical habitat areas.

Risk Level 2 sites have the following site management requirements in addition to all of the requirements listed for Risk Level 1:

1. The site is subject to a pH NAL of 6.5 to 8.5, and a turbidity NAL of 250 NTU.
2. Samples of stormwater runoff must be collected and analyzed for pH and turbidity.
3. Appropriate erosion control BMPs (runoff control and soil stabilization) must be implemented in conjunction with sediment control BMPs in areas under active construction.
4. Linear sediment controls must be applied along the toe of the slope, face of the slope, and at the grade breaks of exposed slopes to comply with sheet-flow lengths in accordance with Table 1 in Appendix D of the Construction General Permit (SWRCB 2010).
5. Construction activity traffic to and from the site should be limited to entrances and exits that employ effective controls to prevent offsite tracking of sediment.
6. All storm drains and perimeter controls, runoff control BMPs, and pollutant controls at entrances and exits must be maintained and protected from activities that reduce their effectiveness.
7. Site access roads must be inspected daily. At a minimum daily and prior to any rain event, construction activity-related materials that are deposited on the roads must be swept or vacuumed.
8. A REAP must be developed 48 hours prior to any likely precipitation event. A likely precipitation event is any weather pattern that is forecast to have a 50% or greater probability of producing precipitation in the study area. The QSP must implement the REAP no later than 24 hours prior to the likely rainfall event.

Work near streams and other sensitive habitat areas may require double silt fences and temporary sediment ponds/traps to provide extra protection and to minimize turbid discharges.

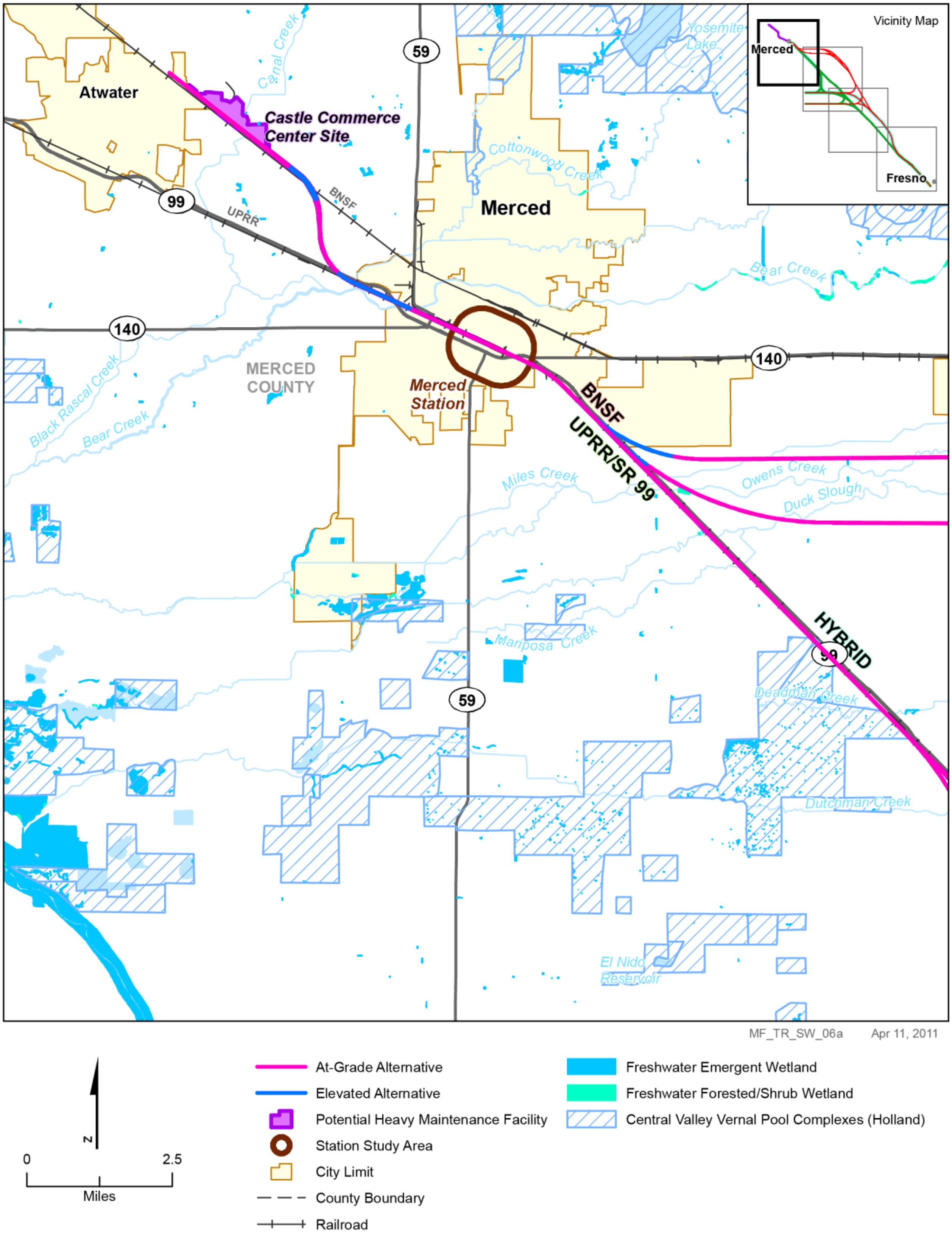


Figure 6-1a
Alternative Project Routes and Sensitive Habitat Areas in the Merced Vicinity

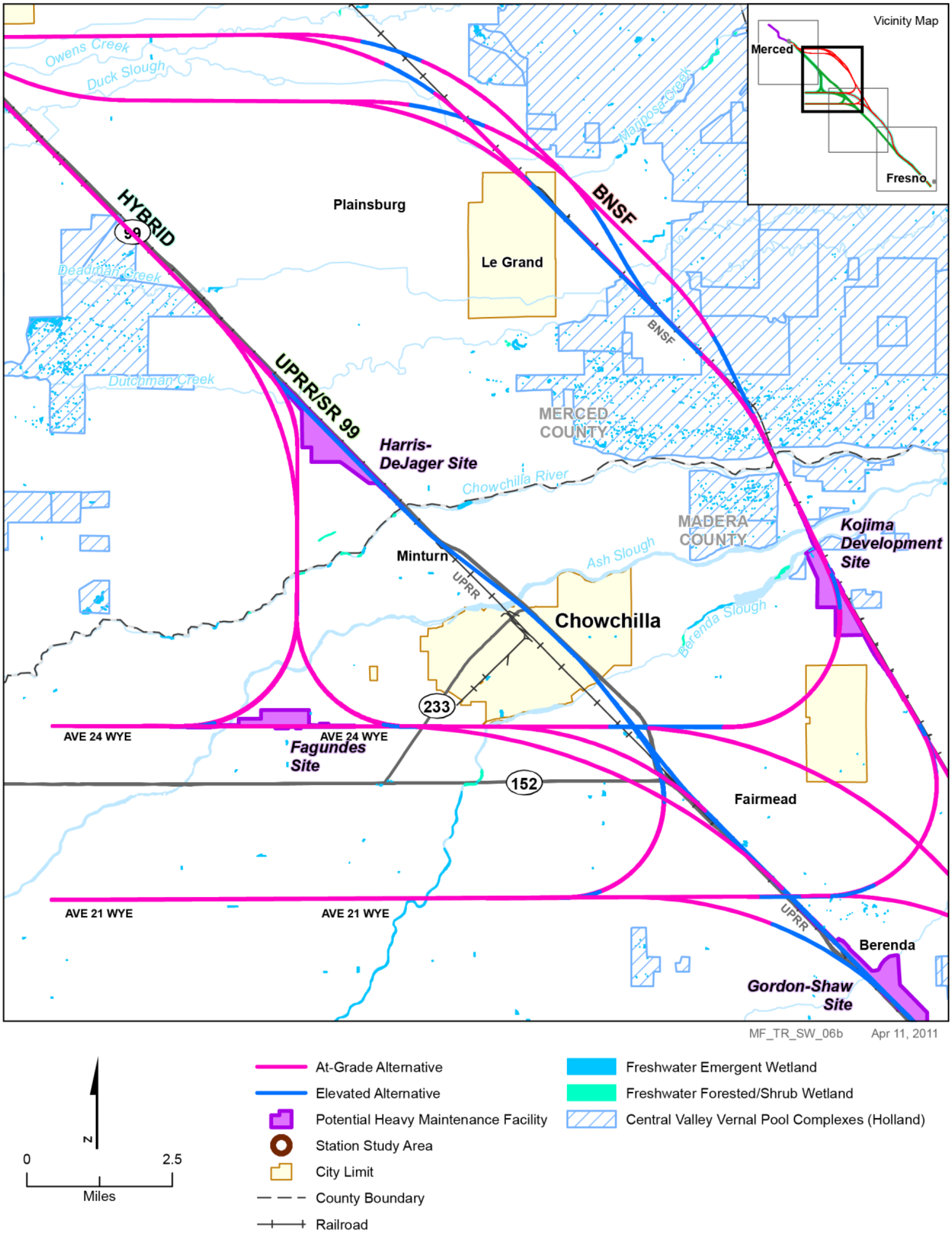


Figure 6-1b
Alternative Project Routes and Sensitive Habitat Areas in the Chowchilla Vicinity

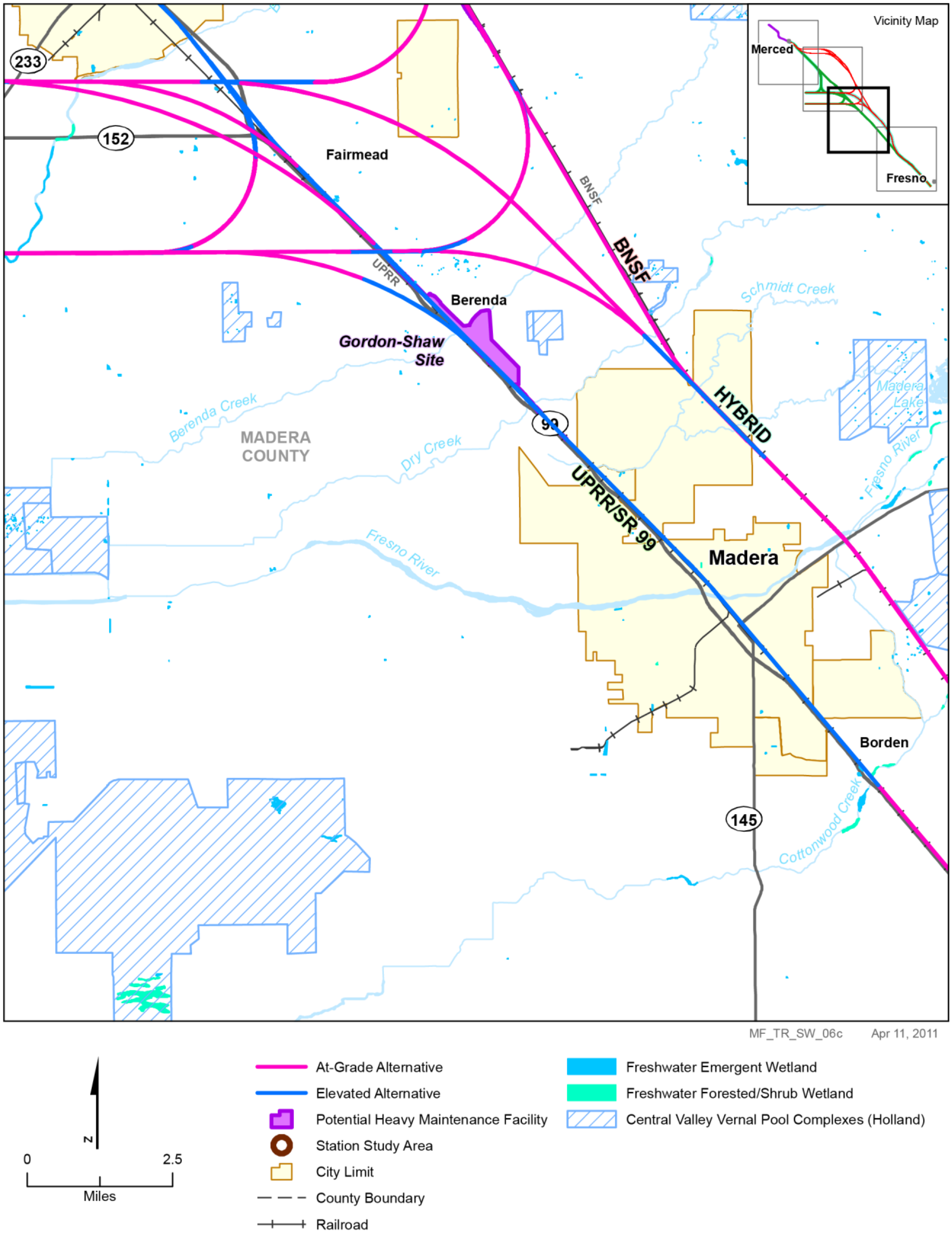


Figure 6-1c
Alternative Project Routes and Sensitive Habitat Areas in the Madera Vicinity

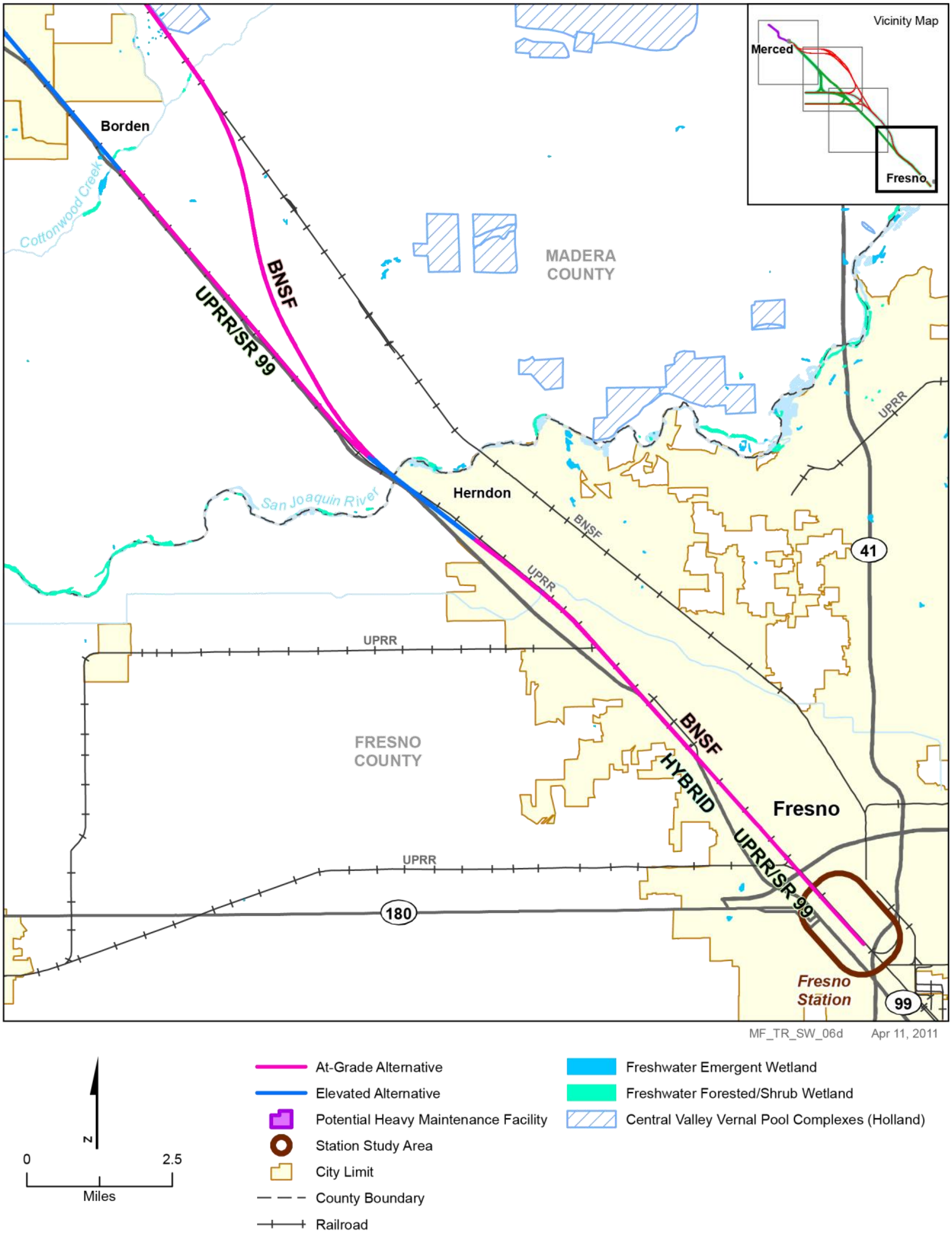


Figure 6-1d
Alternative Project Routes and Sensitive Habitat Areas in the Fresno Vicinity

6.2 Post-Construction

The post-construction stormwater program will be developed based on the PPDG (Caltrans 2010).

6.2.1 Pollutant Removal

Pollutant removal will be accomplished using treatment BMPs, which are measures designed to remove pollutants from stormwater runoff prior to discharging (directly or indirectly) to receiving waters. Caltrans requires that permanent treatment BMPs be considered for all new construction and major reconstruction projects that do not have exemption status. The HST Project does not meet the exemption criteria because it is new construction. The selection of treatment BMPs for the HST Project will be based on the PPDG (Caltrans 2010).

A project must consider treatment for a TDC when an affected waterbody within the project limits is on the Clean Water Act Section 303(d) list of impaired waterbodies for one or more of the Section 303(d)-listed water quality parameters. A parameter meeting this condition is known as a *primary pollutant of concern*. The TDCs indentified in the PPDG include phosphorus, nitrogen, total and dissolved copper, total and dissolved zinc, total and dissolved lead, and sediments. TDCs also include a category known as general metals, which includes cadmium, nickel, chromium, and other trace constituents such as selenium and arsenic. Table 6-2 shows the impaired waterbodies in the study area. None of these waters has been identified as impaired due to a TDC. Therefore, there are no primary pollutants of concern in the study area. Turbidity and total suspended solids are two parameters that should be treated in stormwater runoff. Where the project impacts high-traffic highways and arterials, treatment for metals should also be provided.

Table 6-2
Section 303(d) List of Impaired Waters in the Study Area

Waterbody	Impairment	Source of Impairment	TMDL Completion Date
2006 Section 303(d) Listings			
Bear Creek	Mercury	Resource extraction	2007
San Joaquin River (Friant Dam to Mendota Pool)	Exotic species	Unknown	2019
2008 Section 303(d) Proposed Listings			
Ash Slough (Madera County)	Chlorpyrifos	Unknown	2021
Bear Creek (from Bear Valley to San Joaquin River, Mariposa and Merced Counties)	*Escherichia coli* Unknown toxicity	Unknown	2021
Berenda Creek (Madera County)	Chlorpyrifos Unknown toxicity	Agriculture Unknown	2021
Berenda Slough (Madera County)	Chlorpyrifos	Agriculture	2021
Cottonwood Creek (S. Madera County)	*E. coli* Unknown toxicity	Unknown	2021
Deadman Creek (Merced County)	Chlorpyrifos *E. coli*	Agriculture Unknown	2021
Duck Slough (Merced County)	Chlorpyrifos *E. coli* Sediment toxicity Unknown toxicity	Agriculture Unknown Unknown Unknown	2021
Miles Creek (Merced County)	Diuron	Agriculture	2021

Source: Central Valley RWQCB (2006); Central Valley RWQCB (2008).

The Caltrans-approved treatment BMPs considered for the HST project include biofiltration swales, biofiltration strips, infiltration devices, detention devices, media filters, multi-chambered treatment trains (MCTT), wet basins, dry weather diversion, and gross solids removal devices. With the exception of gross solids removal devices, all of these BMPs are considered effective in removing turbidity, total suspended solids, and particulate metals (Caltrans 2010). With the exceptions of gross solids removal and detention devices, these BMPs are also considered effective in removing dissolved metals. Note that traction sand traps are not considered appropriate for the study area because of the area's relatively warm winter weather and the rarity with which traction sand is ever applied in the region. Other BMPs may also be considered, if found to be needed or appropriate.

At-Grade Track Segments: These areas are non-pollutant generating and, therefore, do not require stormwater treatment.

Elevated Track Segments: These areas are non-pollutant generating and, therefore, do not require stormwater treatment.

Passenger Stations: The HST stations themselves will be largely roofed. They involve mostly foot traffic that would generate few pollutants and would not need to be treated. The access roads and parking lots would receive motor vehicle traffic. Runoff from these surfaces would require water quality treatment for total suspended solids and turbidity. Oil/water separation should also be considered for parking lot runoff.

Heavy Maintenance Facilities: The HMF will be a large facility, covering about 160 acres. The HMF will consist of large, roofed areas and large areas of at-grade track. Runoff from these surfaces would generate very few pollutants and would not need to be treated. Several activities at the HMF would generate pollutants in stormwater runoff that must be treated, as discussed below. It is important that the runoff from the large areas of roofs and train tracks be isolated from untreated runoff from the areas listed below in order to avoid contaminating the relatively clean runoff of the former.

Large numbers of workers will be employed at the HMF. Two-lane access roads and parking for up to 2,000 vehicles would be provided at multiple locations. Runoff from these surfaces would require water quality treatment for suspended solids and turbidity.

The HST trains would be electric and would not require fueling. In contrast, maintenance and other vehicles would be fueled in one or more open areas. Diesel fuel, gasoline, and lubricants would be stored in large underground tanks that would not pose a water quality problem. However, runoff from fueling and fuel transfer areas should flow to an area that can be temporarily isolated in the event of a fuel spill. This runoff should also receive oil/water separation prior to discharge.

Most train maintenance would occur under roofed areas. However, train and service vehicle washing would occur outdoors. Although the wash water would be recycled, runoff from this activity may contain soaps and related cleaning agents. The wash water would be piped to a sanitary waste holding tank or to a municipal sewer, if connection to a sewer system is possible. It would, therefore, pose no threat to water quality. If there were any other unroofed maintenance areas, these would likely generate polluted runoff that must be treated for suspended solids and oils and grease at a minimum (or routed to the sanitary waste system).

All chemicals stored at the HMF would be stored under roofs and not subject to rainfall. The HMF would include an open equipment storage area. Runoff from the surface storage area should be given water quality treatment for suspended solids, at a minimum. The types of equipment proposed for outdoor storage should be carefully analyzed for pollution potential. For instance, utility vehicle storage may generate hydrocarbon releases, while galvanized metals could leach zinc. Additional water quality treatment may be warranted unless the offending equipment is moved under a roof. It is anticipated that stormwater runoff from the HMF will require a permit under the state's Industrial General Permit Program.

Up to 75% of the 160 acres of the HMF site could be converted to impervious surface, resulting in a large increase to stormwater runoff to the local receiving water. This could result in increased stream channel erosion and/or intensified local flooding. To avoid this, onsite stormwater retention (infiltration) or stormwater detention and controlled release will be necessary.

Modified State Highway (SR 99) and State Highway Crossings: Generally, discharges from Caltrans right-of-way would be treated in accordance with the requirements of Caltrans' Project Planning Design Guide. Stormwater best management practices will be used to attenuate, treat, and infiltrate runoff where feasible. While each alternative HST alignment will affect Caltrans facilities in varying locations, the most substantial impacts will occur along SR-99 in Fresno.

The HST Project will require the relocation of 2 miles of SR 99 in Fresno and the modification of several interchanges. Because SR 99 is a high-traffic volume highway, water quality treatment for turbidity, total suspended solids, and metals will need to be provided. A separate Stormwater Data Report (Authority and FRA 2010a) presents this portion of the HST Project in some detail and provides possible stormwater management opportunities. For the SR 99 improvements, these stormwater facilities would be located within the new Caltrans right-of-way limits.

For other Caltrans facilities, the HST Project is not anticipated to require realignment of Caltrans facilities. Project-related improvements to storm water facilities will be located within the existing Caltrans right-of-way.

There are regional flood control facilities, including infiltration basins owned and maintained by Fresno Metropolitan Flood Control District (FMFCD), which may be considered for storm water treatment. These facilities are subject to different NPDES requirements than Caltrans facilities. However, since these regional facilities may be best suited to provide storm water runoff, it is recommended that the project coordinate closely with FMFCD and the Central Valley Regional Water Quality Control Board, as well as Caltrans, during detailed project design.

Modified Intersections: The grade separations of the local road system would result in new or replaced paved road surfaces. Stormwater treatment for total suspended solids and turbidity will be provided. If a high-traffic volume road is involved, metals treatment will also be provided.

6.2.2 Source Control

Source control involves controlling potential pollutant sources before they come in contact with stormwater. Source control measures are particularly appropriate for the HMF site and should include the following measures, where applicable.

- Spill prevention and cleanup: Develop and follow a Spill Prevention and Pollution Countermeasures Plan. Keep adequate quantities of absorbent materials and spill kits readily available. Safely dispose of any spilled materials.
- <u>Storage tanks:</u> Provide secondary containment for storage of petroleum products and other hazardous liquid materials.
- Solid waste: Do not allow trash or debris to accumulate. Provide adequate, covered trash storage bins that are regularly emptied. Store hazardous wastes in separate, covered containers that are properly labeled.
- Vehicle/equipment fueling, maintenance, and washing: Ensure that these activities occur on paved surfaces, under a roof, if practical. Direct any runoff to an isolated sump or sanitary sewer. If directed to the latter, provide oil/water separation. If carried out in the outdoors, berm the area to isolate it and minimize the amount of stormwater that must be treated. Direct runoff to a sump that has an oil/water separator and is equipped with a shutoff valve to isolate the sump in the event of a spill. Provide appropriate treatment and disposal. The activity area and sump should be located at least 100 feet from any offsite storm drain, ditch, stream, or other watercourse.

6.3 Water Quality Design Storm

BMP design depends on the volume and rate of runoff expected, which are affected by the drainage area and configuration, land use, topography, soil characteristics, impervious area, and storm intensity and duration. BMP design is based on a specific design storm and the constituents of concern to be removed. In general, treatment BMPs are designed to treat the flow of smaller, more frequent storm events (rather than rare, high-flow events) with the following common terms:

- Water Quality Volume (WQV) – The aggregate volume of runoff from the design storm for BMP designs based on volume.
- Water Quality Flow (WQF) – The peak design flow for BMP designs based on flow rate.
- The BasinSizer tool may be used to size treatment facilities (http://www.water-programs.com/BasinSizer/Basinsizer.htm)

Water Quality Volume: Defined in the PPDG as the required active storage capacity of stormwater treatment BMPs, the WQV is required in order to size volume-based BMP treatment systems. The WQV for treatment BMPs is intended to provide the level of protection specified by the greater of: (1) regional water quality control board numeric sizing criteria for treatment BMPs, or (2) local government guidelines for sizing stormwater treatment BMPs. When no minimum standards have been established by the appropriate regional water quality control board or local government agency, Caltrans requires a treatment volume that is sufficient to capture 85% of the annual runoff from the project site. For the study area, the WQV established by Caltrans and the Central Valley RWQCB is 0.50 inch. This value is based on a 48-hour drawdown time, and a runoff coefficient of 1.0. The SWRCB recommends using the calculating tool known as BasinSizer (Woody 2010 personal communication).

Water Quality Flow: The WQF has been negotiated between the SWRCB and the Central Valley RWQCB, and is used as the basis for designing the approved filtration-type treatment BMPs. For the study area, the WQF will be calculated using the Rational Method and a precipitation rate of 0.20 inch/hour. This rate is designated in the PPDG for the Central Valley RWQCB. The SWRCB recommends using the calculating tool known as BasinSizer (Woody 2010 personal communication).

Flow Splitters: A major purpose for a flow splitter is to direct WQFs to an off-channel location for stormwater treatment, while allowing peak flows to remain in the channel. Caltrans has drafted design guidelines for flow splitters that direct WQFs and/or WQVs to BMPs while allowing higher flows to bypass (Caltrans 2007a). These guidelines will be followed when designing flow splitters for the HST Project.

6.4 Best Management Practice Evaluation

BMPs will be designed and implemented to reduce the discharge of pollutants from onsite stormwater. Incorporation of BMPs into the onsite drainage system will result in an improvement in water quality from onsite runoff before it enters receiving waterbodies. Constraints that will be evaluated during BMP selection and design include the following:

- Land use (for example, BMPs for culturally and biologically sensitive sites will be managed to reduce impacts).
- Storm drain conveyance viability (for example, the feasibility of draining by gravity to existing local stormwater infrastructure will need to be evaluated).
- Right-of-way and topographic constraints (for example, certain BMPs will be preferred due to space limitations, or accommodated through onsite grading).

- Outlet locations (for example, releasing directly to major streams would reduce potential erosion on hillsides).

Biofiltration Swales/Strips: Biofiltration swales (bioswales) are open, shallow, vegetated channels that receive directed flow and slowly convey stormwater to downstream discharge points. Biofiltration strips (biostrips) are vegetated sections of land over which stormwater flows as overland sheet flow. Bioswales and biostrips are designed to remove pollutants by straining runoff through the grass or other vegetation in the channel, slowing flow to allow for sedimentation, filtering through a subsoil matrix, adsorption to soil particles, and infiltration into the soil. Swales can be natural or manmade. Biostrips and bioswales are mainly effective at removing debris and solid particles, although some dissolved constituents are removed by adsorption onto the soil. These BMPs are most applicable in areas where site conditions and climate allow for the establishment of vegetation, where flow velocities are low, and where the length of flow through the bioswales or across the biostrips can be maximized. In accordance with the Caltrans Treatment BMP Technology Report (Caltrans 2007b), bioswales have good removal efficiencies for metals and total suspended solids, which are pollutants of concern.

Bioswales will be considered at locations along the alignments where longitudinal slopes are 3% or less, and where right-of-way requirements would not conflict with other environmental mitigation. For successful treatment, a bioswale must achieve a minimum hydraulic residence time of 5 minutes. A key consideration in the design of bioswales is to have peak design-flow velocities less than 4 feet/second through the channel to avoid erosion. Much of the alignment is at longitudinal grades less than 1% because of the relatively flat local topography and the need for gradual changes in the vertical track alignment. Such grades generally allow design flows to remain below 4 feet/second. As a result, bioswales may be considered technically feasible in some locations; however, swales generally require more right-of-way than underground drainage systems and a reliable water supply to sustain design vegetation. These restrictions may limit the use of bioswales and biostrips.

Infiltration Devices: An infiltration basin is a device designed to remove pollutants from surface discharges by retaining stormwater runoff and infiltrating it directly into the soil without release to surface waters. The feasibility criteria for infiltration basins require a design WQV that exceeds 0.1 acre-foot, sufficient soil infiltration rates, sufficiently low water table, and no threat to local groundwater quality. Infiltration basins are a good choice for surface water protection where permeable soils support their use and there is sufficient area or right-of-way.

Currently, most stormwater runoff in the Fresno and Merced vicinities are routed to retention ponds for infiltration. Soils along the HST alignment are highly variable. Soils falling in HSGs A and B are generally suitable for infiltration. HSG C soils may also be suitable if local studies confirm suitable infiltration capability. HSG D soils are generally unsuitable for infiltration due either to poorly infiltrating soils or shallow depth to bedrock or the water table. HSG D soils are predominant in the middle portion of the Merced to Fresno Section. Many of the crossed streams are ephemeral or intermittent with sandy bottoms (see Figure 6-2) and potentially sandy floodplains; however, further investigation will be required to determine local soil types and infiltration potential, both near the streams and at a distance. Infiltration basins are common in the Merced and Fresno areas. There is a high potential for HST runoff to be routed to storm drains that lead to existing retention ponds.

Detention Devices: A detention basin is a permanent device that temporarily detains stormwater runoff under calm, non-turbulent conditions such that sediment and particulates are able to settle before the runoff is discharged. A portion of the detained water is also lost due to infiltration (if the basin is unlined) and evaporation. Detention basins remove litter, settleable solids (debris), total suspended solids, and pollutants that are attached (adsorbed) to the settled particulate matter. Detention basins are primarily suited for sites where the water quality volume is at least 0.1 acre-foot, where the seasonal high groundwater is below the bottom of the basin, and where an elevation difference is available so that water stored in the basin does not cause objectionable backwater conditions in the storm drain systems. Detention basins should be designed to drain within 72 hours so as not to promote vector problems. In

accordance with the Caltrans Treatment BMP Technology Report (Caltrans 2007b), detention basins have good removal efficiencies for total metals (mainly those in particulate form) and suspended solids, which are pollutants of concern.

Figure 6-2
Examples of a Sandy, Ephemeral Stream (Berenda Slough near BNSF Alternative)

Media Filters: Media filters primarily remove particulates from runoff by sedimentation and filtration, and are effective for removing dissolved metals and litter. Media filters require sufficient hydraulic head (3 feet) to operate by gravity. There are two common types of sand filters:

- Austin sand filters typically have an open top, are designed at grade, and have no permanent water pool. An Austin filter may be configured with earthen or concrete sides. Austin style media filters are technically feasible for the HST project.

- Delaware sand filters are configured with closed concrete chambers to allow the surface above the filter to be hardened for project use. The filter media is below grade and has a permanent pool of water, which is a concern for vector control. Delaware style media filters are suitable for relatively small drainage areas where surface use over the filter is required, such as may be the case at the passenger stations or the HMF. However, the relatively high cost of Delaware sand filters is a key consideration if they are considered for the HST Project.

Multi-Chambered Treatment Train (MCTT): The MCTT is a stormwater treatment device that uses different treatment mechanisms in each of three separate chambers. The MCTT was developed for treatment of stormwater at critical source areas, such as service facilities, parking areas, paved storage areas, and fueling locations. The minimum WQV for MCTTs must be greater than or equal to 0.1 acre-foot. MCTT siting guidelines indicate that they should be considered if the pollutant concentrations are significantly above those found in the runoff from the state highway system. MCTTs may be appropriate for the HMF and possibly portions of the passenger stations.

Wet Basins: A wet basin is a detention system that comprises a permanent pool of water, a temporary storage volume above the permanent pool, and a shoreline zone planted with aquatic vegetation. Wet basin design requires a minimum WQV of 0.1 acre-foot and a permanent source of water for a permanent pool. It is unlikely that a permanent source of water will be available for a

new wet basin facility; and a permanent pool could also cause concerns with vector control. Therefore, a new wet basin is an unlikely BMP choice.

Dry Weather Diversions: Locations that may include irrigation (such as potential planting strips at passenger stations) will include provisions to ensure that over-irrigation does not occur.

Gross Solids Removal Devices (GSRDs): GSRDs remove gross solids (defined as a particle about 5 mm square or larger) and are specifically targeted for trash and debris. GSRDs may be appropriate at the passenger stations or at-grade tracks in urban areas, but debris can often be effectively removed using BMPs for smaller particles.

7.0 Hydromodification Management

For project locations where onsite stormwater dispersion, infiltration, or conveyance to an existing stormwater system is not feasible, hydromodification management should be considered. This is particularly true for larger project sites, such as the HMF, that may result in large increases in post-project runoff.

7.1 Definition of Hydromodification

A self-sustaining stream within a healthy watershed evolves naturally within an unconfined floodplain through unconstrained channel-forming processes and frequent flooding. The stream adjusts its channel dimensions (width and depth) in response to long-term changes in sediment supply, recurring streambank overflow events, and local geologic conditions.

Hydromodification is a development-induced change to natural hydrological processes and runoff characteristics. In general, hydromodification reduces groundwater recharge, reduces baseflow (groundwater flow into streams), and increases peak surface runoff into streams, altering the natural stream-forming processes and flood response. Examples of hydromodification include the following:

- Increased runoff and erosion due to removal of natural vegetation.
- Newly constructed impervious surfaces that reduce infiltration and accelerate local runoff; these surfaces increase stormwater runoff, resulting in channel erosion or sedimentation.
- Channelization of a creek or stream by straightening, widening, deepening, or relocating the channel.
- Modified hydrographs due to reservoirs, diversions, levees, canals, borrow pits, or dredging.

Hydromodification management for development-induced stormwater runoff uses techniques to retain, detain, or infiltrate runoff to mimic pre-project flows, durations, and associated sediment transport for a specified range of smaller, more frequent rain events. Standard water pollution control BMPs are designed for pollutant removal to capture and treat specified flows from pavement runoff (the water quality flow or the water quality volume; see Section 6.3). But such facilities may not fully control the effects of hydromodification. Typical hydromodification management approaches include detention basins that lower peak flow rates, bypass pipelines that redirect flows to less erosive stream segments, and flow splitters designed to redirect a portion of the urbanized flow to mimic pre-project flow rates within the drainage sub-areas.

7.2 Requirements for Hydromodification

Hydromodification control facilities are generally not required for minor runoff to large streams because the incremental increase in stream flow is negligible, and the timing of peak stormwater runoff is not likely to correspond in time with the arrival of peak flooding from the larger basin. Hydromodification management is more important where there are smaller, erosive hillside channels or steep hillsides (such as the sides of stream gullies), and upstream of areas with known bank instability, sensitive habitat, or restoration projects (such as restoration of San Joaquin River salmonid populations).

There are a number of approaches to sizing hydromodification control facilities and two are summarized below. As the project design progresses, discussions should be held with Caltrans, the Central Valley RWQCB and the appropriate local municipalities to reach agreement on the design approach for any hydromodification control facilities that may be identified for the HST Project.

Studies show that 90% to 95% of erosion occurs by flows that exceed the critical shear flow of the channel and by flows that are less than the 10-year storm event (Santa Clara Valley Water District

2005). The critical shear flow of a channel is defined as the flow that produces the critical shear stress necessary to initiate motion of bed material or erosion of bank material. The critical shear flow rate has been estimated at approximately 10% of the 2-year storm event flow (Santa Clara Valley Water District 2005); this rate has been incorporated into hydromodification management plans for Santa Clara Valley Water District (2005), Alameda County (2005), San Mateo County (2005), and Contra Costa County (2005). Therefore, hydromodification control facilities should be designed to mimic pre-project flows for return periods up to the 10-year event.

The revised General Construction Stormwater Permit issued by the SWRCB contains significant post-construction stormwater requirements for project sites that lie outside of Phase I or Phase II communities (see Section 4.3). Phase I and Phase II communities are typically communities with populations greater than 10,000 that already possess stormwater permits. If a project site lies outside a Phase I or Phase II community, then a hydromodification control facility should be designed such that the post-construction runoff flows replicate preconstruction runoff volume up to the 85th percentile storm event. A continuous stormwater model such as SWMM or HSPF may be developed to demonstrate that this condition is achieved. Alternatively, a spreadsheet method supplied by the SWRCB may be used to demonstrate compliance with this requirement.

Local jurisdictions may have additional requirements for hydromodification control and should be consulted.

7.3 Approach to Hydromodification Management

7.3.1 Flow Duration Control

Traditional stormwater flow management facilities are designed to limit a peak flow rate for a single design storm event. However, such facilities typically allow the duration of non-peak flows that are geomorphically significant (i.e., they exceed the critical shear stress and, therefore, are capable of transporting sediment) to increase between pre- and post-project conditions. This can increase erosion in the downstream channel. Hydromodification control facilities can be designed to control both the peak flows and the duration of geomorphically significant flows.

Flow duration curves are computed for pre- and post-project runoff at the drainage system outlet using a continuous hourly rainfall record for a minimum of 20 years. The post-construction flow duration curve can be modified using hydromodification control facilities that incorporate a staged outlet structure. Through iterative adjustment of the facility size and outlet structure, the post-construction flow duration curve is then designed to match the pre-project flow duration curve as closely as possible.

7.3.2 Continuous Hydrologic Modeling

The flow duration approach for designing hydromodification facilities considers the entire multi-year discharge record, as opposed to a single event. Time-varying runoff is calculated from historical gauged precipitation data applied to the drainage area. This is referred to as continuous hydrologic modeling. A common approach to continuous hydrologic modeling is use of USEPA's SWMM.

For the HST project, runoff would be calculated using hourly rainfall data from a rain gage in the general study area that has a minimum continuous rainfall collection period of at least 20 years. SWMM's non-linear runoff routing method is used for hydrologic modeling of a drainage area. This method generates overland flow hydrographs by a routing procedure using Manning's equation and a lumped continuity equation. Input parameters include tributary surface area, topographic features, impervious and pervious surface area percentages, infiltration characteristics for pervious surfaces, depression storage, evaporation rates, surface roughness (characterized by a Manning's n value), and the width and slope for overland flow.

Infiltration is calculated using Horton's equation where the infiltration rate decreases exponentially from an initial maximum rate to a minimum constant rate over the course of a rainfall event. Once depression storage of the ground surface is exceeded (after accounting for both infiltration and evaporative losses), sheet flow runoff is routed overland to the downstream end of a drainage sub-area. This is accomplished assuming a Manning's n value consistent with the type of land use. At the downstream end of the sub-area, where flow has concentrated, the runoff is routed through a concentrated flow path (channel, ditch, or pipe) using dynamic wave routing governed by Saint Venant's flow equations. The dynamic wave routing accounts for such items as storage along the flow path, the backwater effect of downstream restrictions (weirs, orifices, and constrictions), entrance/exit losses, and surcharged flow.

Calculations are conducted over the entire rainfall period for the existing condition (pre-project) and along the entire drainage network for the proposed condition (post-project). The program also models complex hydraulic conditions normally found in drainage systems (including flow regulation devices such as orifices and storage devices such as detention basins). The final output is a flow duration curve that shows the discharge on the abscissa and the percentage of time this discharge is equaled or exceeded on the ordinate. A detention basin and outlet typically consists of a series of orifices in a pipe riser, which are sized to mimic the pre-project flow duration curve. This is achieved by modifying the storage-discharge relationship in a trial-and-error process using the SWMM model.

7.3.3 Precipitation

In order to perform continuous hydrologic calculations, a continuous rainfall record is required. A minimum record for 20 years is usually necessary, at a maximum recording time interval of 1 hour. Three rain gages near the HST alignments that appear to have suitable data have been identified and are shown in Figure 7-1. Two of the gages are located in Fresno and in Merced. A third suitable gage (Friant) lies to the east of the study area. The link to the rain gage data is given below:

http://cdo.ncdc.noaa.gov/pls/plclimprod/cdomain.abbrev2id?datasetabbv=DS3240&countryabbv=&GEORegionabbv=&Forceoutside=

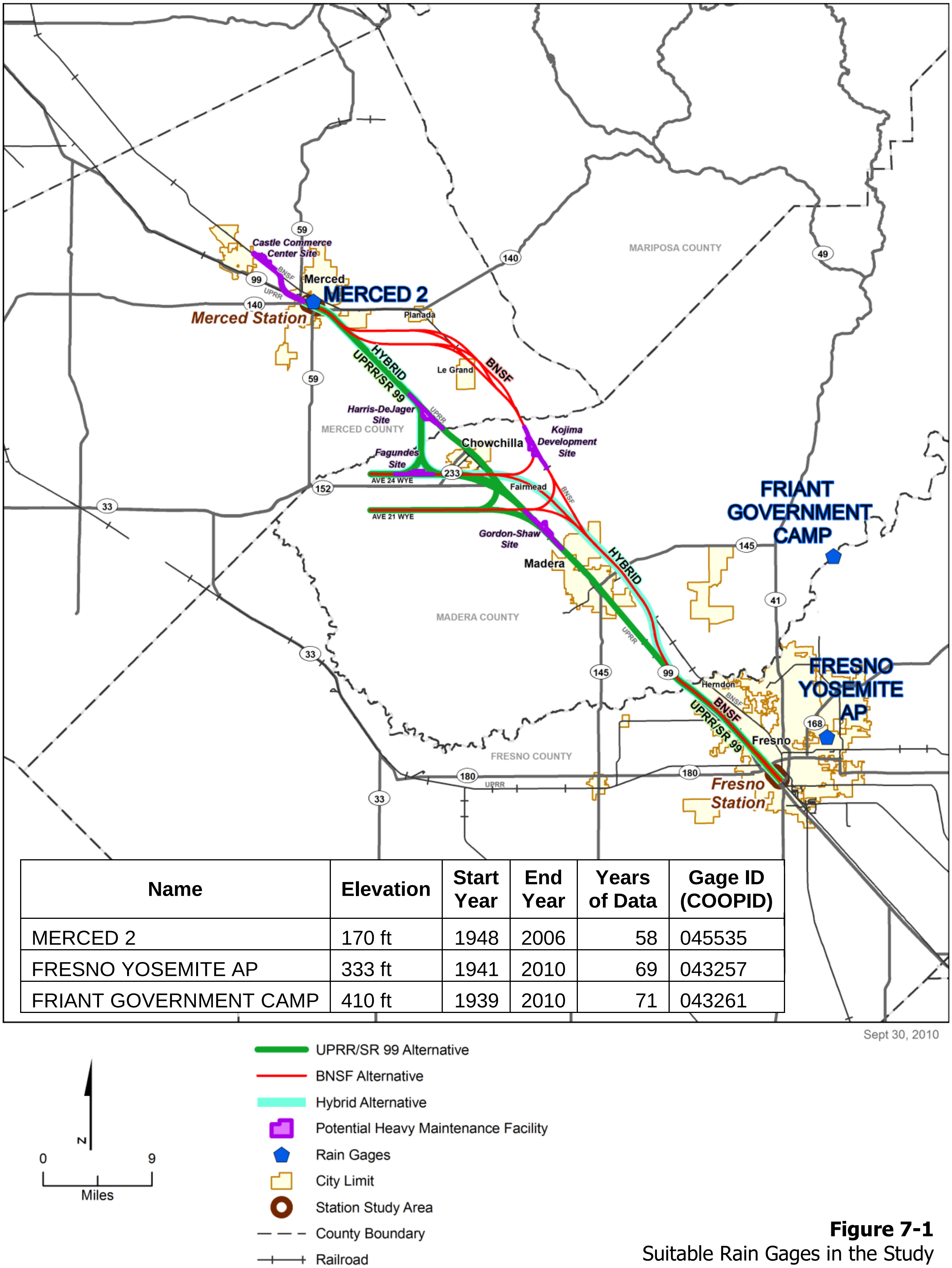
The usefulness of the rainfall data from these or other gages that may be used should be verified at the appropriate phase in the design.

7.3.4 Flow Duration Curve

The flow duration curve is the final product of the SWMM modeling effort. It illustrates the number of hours of flow higher than or equal to each flow rate from the continuous simulation. The effectiveness of the hydromodification facilities is shown from the difference between the pre-project flow duration curve and the post-project flow duration curve. For flow rates greater than the pre-project flows, a maximum 10% difference is allowed between any points on the pre- and post-project curves for the facilities to be considered effective in mitigation of potential adverse effects. A pre-project and post-project curve would be generated at the project discharge point, along with a curve showing post-project flows without detention, for reference.

7.3.5 Detention Basins

Hydromodification design procedures for detention basins discharging to natural channels include sizing the basin for hydrograph attenuation to reduce the discharged flow to match existing conditions. A detention basin also can provide water quality treatment (settling of sediment) and typically results in a basin size that is two to four times larger than the water quality volume. The outlet should be designed to meter flows at a rate that mimics the flow duration curve for the pre-project conditions. A further design requirement that is frequently applicable is to limit the maximum drawdown time for the detention basin to 72 hours in order to avoid the development of vector problems.



Name	Elevation	Start Year	End Year	Years of Data	Gage ID (COOPID)
MERCED 2	170 ft	1948	2006	58	045535
FRESNO YOSEMITE AP	333 ft	1941	2010	69	043257
FRIANT GOVERNMENT CAMP	410 ft	1939	2010	71	043261

Figure 7-1
Suitable Rain Gages in the Study Area

8.0 Groundwater

8.1 Groundwater Aquifers

The California Central Valley heavily relies on groundwater for agricultural and urban uses. Regional groundwater and stormwater management plans within the Central Valley are closely linked in order to promote watershed management and conjunctive use of groundwater supply. The study area is divided into four different groundwater basins (Figure 8-1):

- Merced Groundwater Basin
- Chowchilla Groundwater Basin
- Madera Groundwater Basin
- Fresno Groundwater Basin

The aquifer system underlying the Central Valley is confined by beds and lenses of fine-grained silts and clay that do impede the flow of water. Corcoran clay is a low-permeability, aerially extensive, lacustrine deposit that extends throughout much of the Central Valley. It underlies the northern half of the Merced to Fresno Section. Lenses of Corcoran clay divide the basins into an upper semi-confined zone and a lower confined zone. These low-permeable barriers hinder vertical flow and create significant hydraulic gradients with depth.

8.2 Groundwater Use

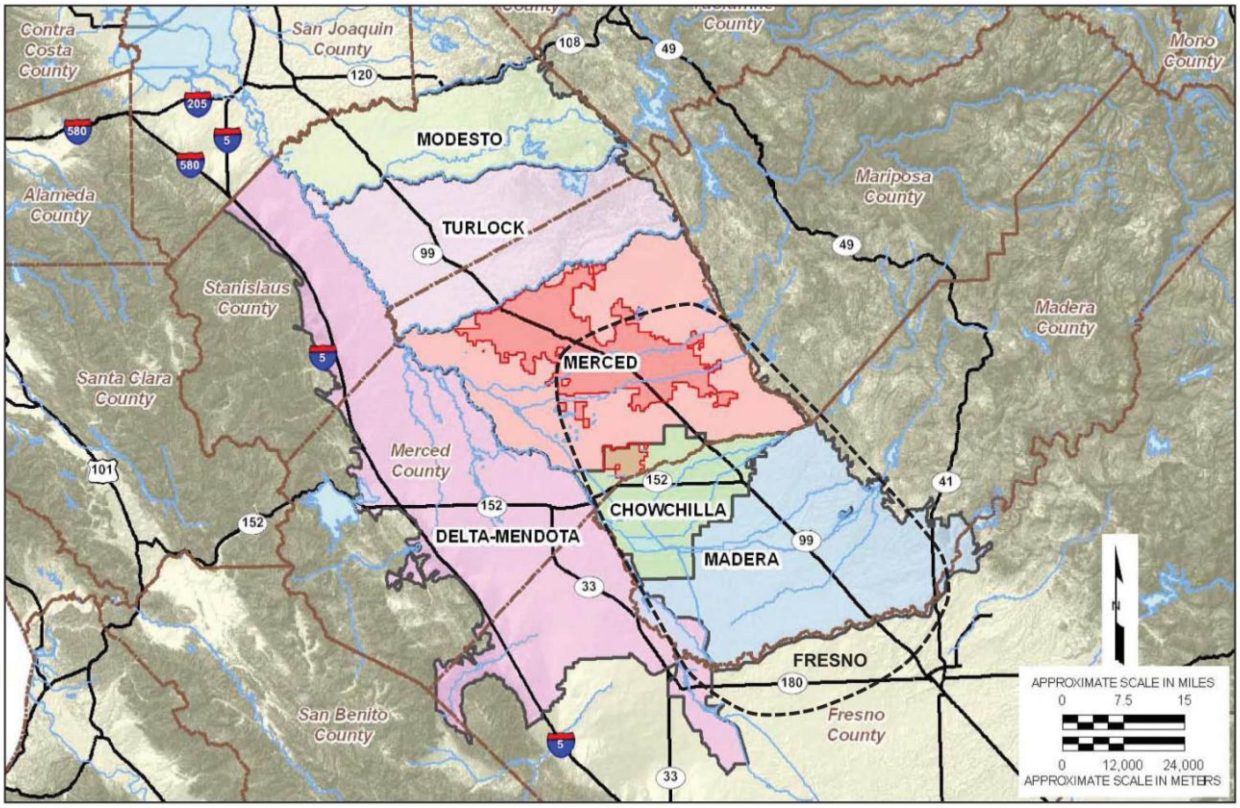
Groundwater withdrawals since the mid-1900s have significantly altered the Central Valley's water budget. Pumped groundwater is the largest discharge from the natural aquifer system. Despite the greater availability of surface water resulting from state and federal water projects completed over the past 60 years, groundwater continues to be a major source for both irrigation and municipal use in the Central Valley. Groundwater continues to supply more than half of the irrigation water needs in the study area. The fraction of irrigation deliveries that is derived from groundwater varies by year, season, location, and type of use. Groundwater withdrawals increase in droughts and decrease when there is more surface water available.

Groundwater use has increased with population growth, and is the primary source of municipal and industrial water supply in the San Joaquin Valley. Merced, Chowchilla, Madera, and Fresno rely solely on pumped groundwater to meet urban demand. Consequently, USEPA designated most of Fresno County as a Sole Source Aquifer in 1979 (Figure 8-2). USEPA's Sole Source Aquifer Program recognizes the unique need to protect aquifers that supply 50% or more of a community's drinking water from contamination. Projects that can potentially contaminate approved sole source aquifers cannot receive federal assistance.

8.3 Groundwater Depletion

Beginning at the north end of the study area, most of Merced County is within areas where the depth to groundwater is less than 50 feet (Figure 8-3). Downtown Merced is highly urbanized and the accompanying increase in impervious surfaces, such as parking lots and buildings, has reduced the potential for groundwater recharge. Currently, groundwater withdrawals exceed recharge levels and notable groundwater depressions exist south and southwest of the City of Merced (DWR 2004).

The Merced Area Groundwater Pool Interests (MAGPI) is a joint-powers authority consisting of stakeholders in the Merced Groundwater Basin, including agencies in Atwater, Le Grand, Planada, and Merced. MAGPI was chartered to create and execute a management plan for the protection and conjunctive use of groundwater in the Merced basin. The management plan is intended to mitigate groundwater overdraft through supplemental recharge to the Merced and Madera Groundwater Basins.



---- Study Area

Source: Amec Geometrix 2008.

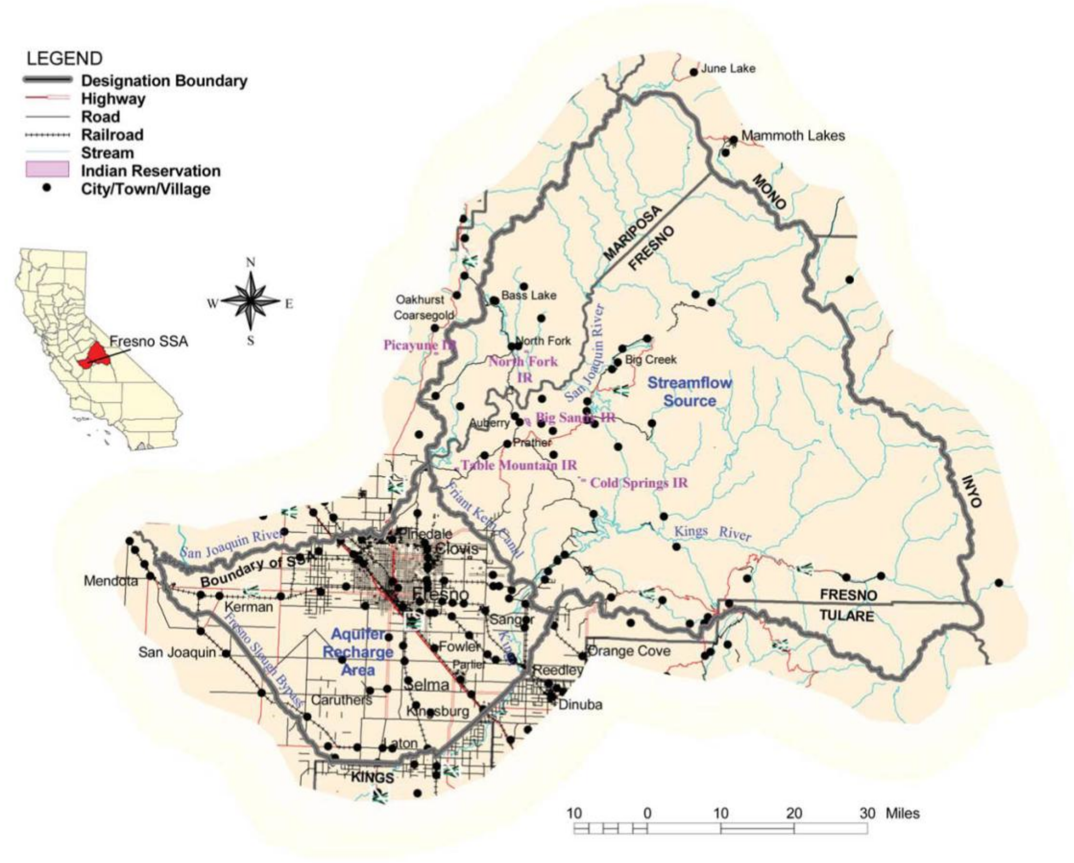
Figure 8-1
Groundwater Basins in the Study Area

In Madera County, groundwater is the main source of both urban and agricultural water. The current average annual overdraft in the valley floor portion of Madera County, which includes the study area for all of the HST alternatives, is approximately 100,000 acre-feet per year (Madera County 2008). This area includes both the Madera and Chowchilla subbasins. In the city of Madera, favorable recharge areas have been identified south and southwest of the city where coarse-grained sediments are present.

Throughout much of Fresno County, the groundwater basin is overdrawn (Fresno County 2000), with notable groundwater depressions near the Fresno and Clovis urban areas (California Department of Water Resources [DWR] 2006). Downtown Fresno is highly urbanized and the accompanying increase in impervious surfaces, such as parking lots and buildings, has reduced the potential for groundwater recharge at the Downtown Fresno Station study area. In order to mitigate aquifer depletion due to pumping, the Fresno Metropolitan Flood Control District has combined its flood control and urban drainage programs with groundwater recharge. Flood control reservoirs and infiltration basins serve dual purposes to reduce peak flows and recharge groundwater in the Fresno basin. The District's facilities provide approximately 17,000 acre-feet of annual stormwater recharge, infiltrating more than 80% of stormwater runoff (Fresno Metropolitan Flood Control District 2009).

8.4 Groundwater Quality

Groundwater in the study area tends to be high in sodium bicarbonate, with associated low total dissolved solids, hardness, iron, and manganese; however, there are localized areas of high hardness, iron, nitrate, and chloride in the subbasins (DWR 2006). Septic disposal systems and leach fields, fertilizers, animal manures, geologic sources, and plant residues are potential sources of nitrate contamination.



Source: US EPA Region 9 GIS Center, February 2002.

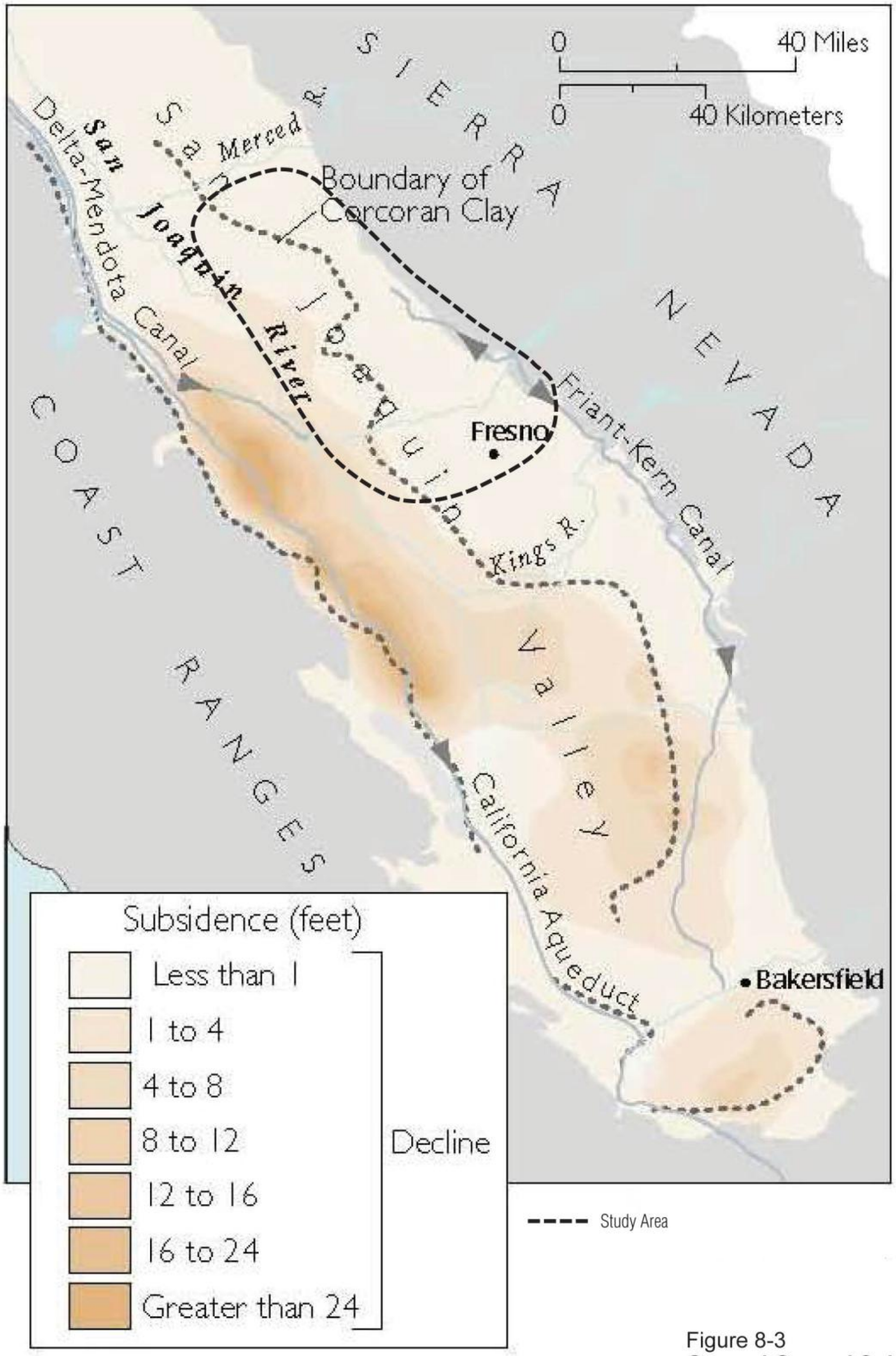
Figure 8-2
Fresno Sole Source Aquifer

8.5 Groundwater Impacts

Two important groundwater considerations for the HST Project are land subsidence and well locations. Land subsidence due to overdraft of groundwater was a major occurrence in portions of the Central Valley in the 1960s and 1970s, resulting in damage to buildings, aqueducts, bridges, and highways. Ongoing subsidence has the potential to impact linear projects, such as the HST. However, areas within the study area with the greatest land subsidence lie to the west of the SR 99 corridor, well away from the proposed rail alternatives (Figure 8-3). Within Merced, Madera, and Fresno counties, subsidence has caused at most 4 feet of subsidence and in most areas less than 1 foot; therefore, subsidence should be manageable with proper design and monitoring.

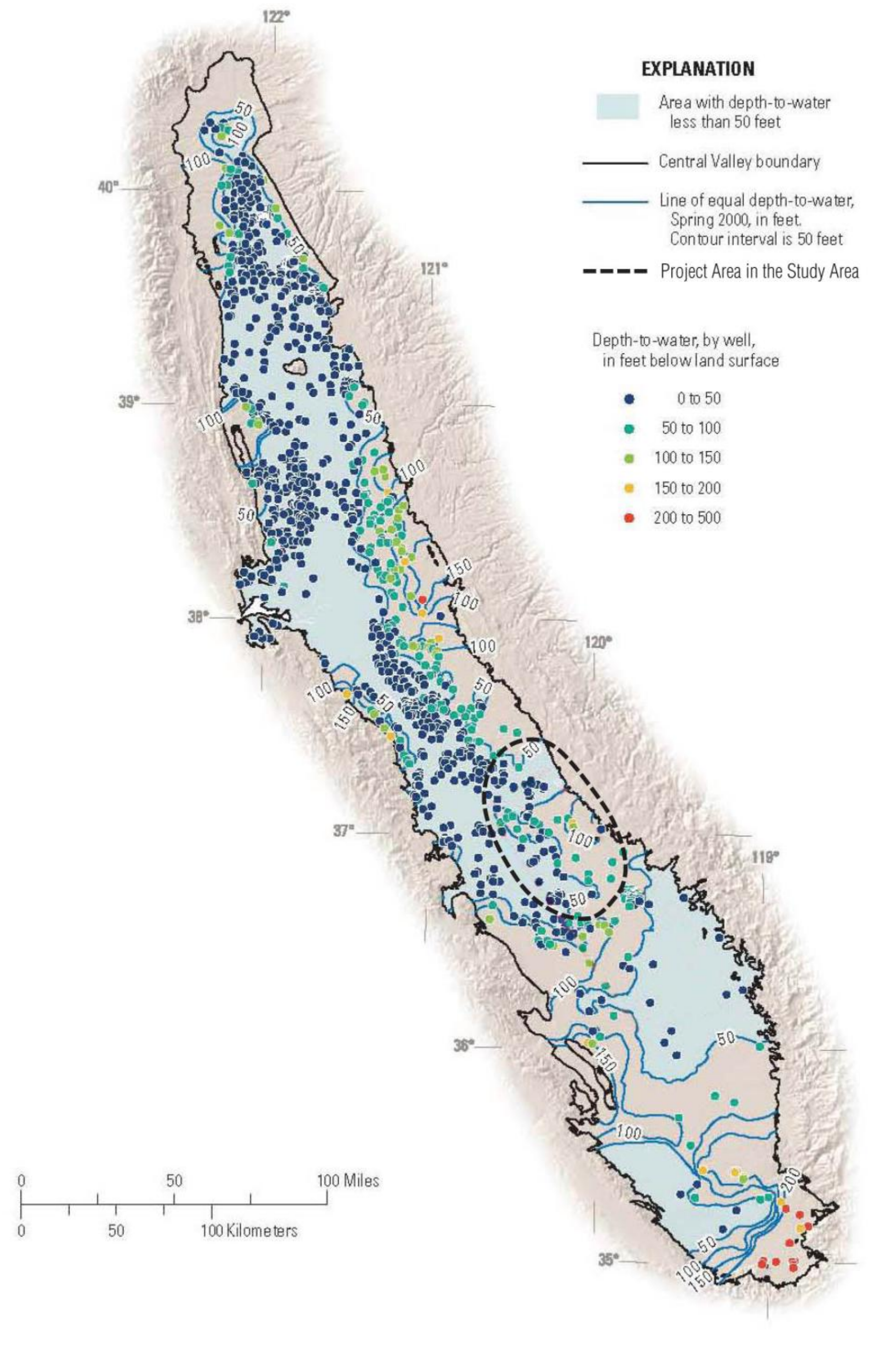
Another important design consideration is the location, depth, and density of groundwater wells along the HST alignments because impacted wells may need to be relocated. Groundwater depths along the alignments vary from between less than 50 feet to 150 feet in Merced, Madera and Fresno counties. Figure 8-4 illustrates the relative density of wells in the study area. The impact of the project on individual wells will be examined in a later phase of the HST Project.

Land Subsidence from 1926 to 1970



Source: Galloway 1999.

Figure 8-3
General Ground Subsidence in the Study Area



Source: Belitz et al, 2009.

Figure 8-4
Depth to Groundwater in Study Area

9.0 Conclusions

The Merced to Fresno Section of the HST Project extends over 60 miles and consists of a variety of project elements, including at-grade and elevated guideway, two passenger stations, an HMF, modified intersections, and changes to portions of SR 99. Over this distance, the project crosses more than 100 waterbodies, including 18 creeks or rivers and numerous irrigation canals, ditches, and culverts.

In support of the 15% project design, this SWMP identifies the general regulations and BMP choices and issues that need to be considered and addressed as design progresses.

Significantly, the elevated and at-grade portions of track are considered non-pollutant generating. Runoff from these tracks would, therefore, not require stormwater treatment. There are substantial opportunities to locally disperse and infiltrate track runoff, which will minimize stormwater impacts for much of the HST Project. Stormwater management will be more robust at the following locations:

- Passenger stations, where there will be impervious surfaces and issues of trash and pollution from human activity and transportation connections.
- The HMF site, where train cars will be cleaned and repaired.
- Modified intersections, where new or replaced impervious, pollutant-generating surfaces will fall under local jurisdictions.
- Modification to SR 99, including realignments, where new or replaced impervious, pollution-generating surfaces will fall under Caltrans jurisdiction.

The HST Project will generally maintain existing drainage flow patterns. Overall, low impact development measures such as runoff dispersion and infiltration will be a dominant means of managing stormwater runoff, particularly along the tracks. Where appropriate, the HST System will convey project-related highway runoff to treatment BMPs located within highway right-of-way via storm drain systems equipped with grated catch basins. Intensive runoff control and treatment measures would be incorporated at the HMF site.

Storm flow rates and hydraulic grade lines in the crossed creeks will remain essentially unchanged. Offsite storm flows will be conveyed across the project right-of-way under bridges at the major creek crossings, through cross-culverts at minor existing water courses, and in numerous longitudinal ditches that will intercept and convey surface water to the culverts. Culverts will be equipped with energy dissipaters and transition structures to preclude erosion at the culvert outlets as necessary.

The design may also incorporate hydromodification management to control flow at specified locations to mimic pre-project flow rates and durations for management of erosion and sediment. The hydromodification project features would be in addition to Caltrans standard water pollution control facilities. Hydromodification controls would be located where outflow is directed to smaller tributaries where the change in flow may result in increased sediment transport. At a minimum hydromodification control facilities would be designed to replicate the pre-project peak stormwater runoff volume up to the 85th percentile storm event, as required by the State General Construction Stormwater Permit.

The HST Project is located in an area that has generally mild slopes and the erosion potential is low. Various slope and surface protection measures will be used to address site soil stabilization and reduce erosion potential. Typical measures include application of soil stabilizers such as hydroseed, rock slope protection, velocity dissipation devices, and culvert transition structures. The HST Project will also use retaining walls to reduce the steepness of slopes or to shorten slopes and provide cut

and fill slopes that are flat enough to allow revegetation and limit sediment transport to preconstruction rates.

Prior to construction, an SWPPP will be prepared that incorporates the requirements for water pollution control during construction. The SWPPP will include such items as:

- Source identification and control of potential pollutants
- Erosion control for temporary, permanent, and wind conditions
- Sediment control with the specific objective of maintaining sediment loads consistent with preconstruction levels
- Non-stormwater runoff control
- Specific controls for work above and adjacent to waterways, wetlands, and other sensitive areas
- Contractor training
- Scheduling
- Where the project either impacts or lies within 200 feet of a critical area, a stormwater runoff sampling plan designed to monitor water pollution control effectiveness

In conclusion, this SWPPP has outlined a strategy for stormwater management for the HST Project. Specific issues addressed include the following:

- Onsite stormwater retention
- Management of stormwater peak flows and overall hydrographs
- Concentrated flow conveyance systems
- Slope and surface protection systems
- Potential project design elements
- General source control, pollution prevention, and treatment BMPs

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APPENDIX A

Risk Level Determination

APPENDIX A

Risk Level Determination

Prior to the start of construction, the project will need to obtain coverage under the new state Construction General Permit for Discharge of Stormwater from a Construction Activity, which became effective on July 1, 2010. The Construction General Permit can be found at:

http://www.swrcb.ca.gov/water_issues/programs/stormwater/constpermits.shtml

In order to obtain coverage under the General Construction Permit, a Notice of Intent must be filed with the State Water Resources Control Board at least 30 days prior to the start of construction. The Construction General Permit requires that project risk level determination be carried out. Risk level is determined by the combination of sediment risk and receiving water risk analyses. There are three levels of risk: Risk Level 1 through Risk Level 3. The risk level determination worksheet can be found at:

http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

The risk level determination worksheet exists in both PDF and Excel format. The Excel spreadsheet includes following tabs: Sediment Risk, Sed. – Map Option, Receiving Water Risk, Combined Risk, K (soil erodibility factor), (LS) Slope/Length factor, and Sediment-Impaired Water Bodies.

There are three steps associated with risk level: 1) determine sediment risk, 2) determine receiving water risk and 3) combine the results of #1 and #2 to determine overall risk level. Overall project risk level was determined as follows:

Step 1: Determine Sediment Risk:

The GIS Map Method (Sed. – Map Option Tab) was used to estimate the product of K x LS (Figure A1-1), from the Universal Soil Loss Equation. A factor of 0.3 was estimated for the study area from the GIS Map.

The R factor for the Equation was estimated using with the USEPA Rainfall Erosivity Calculator, which can be found at:

http://cfpub.epa.gov/npdes/stormwater/lew/lewcalculator.cfm

The annual R factor varied from 14 in Fresno to 19 in Merced. The product of R and (K x LS) yields an estimate of the annual sediment load from a disturbed (construction) site. This product varies from 4.2 (Fresno) to 5.7 (Merced) tons/acre/year.

Sediment risk is then assigned as follows:

Less than 15 tons/year: low sediment risk (LSed)
15-75 tons/year: medium sediment risk (MSed)
Greater than 75 tons/year: high sediment risk (HSed)

Construction in the study area varies from about 4-6 tons/acre/year. Therefore, it falls within the low sediment risk category.

Step 2: There are two parts to determining Receiving Water Risk: A) sediment sensitive watersheds and B) sensitive beneficial water uses.

A. List of Sediment Sensitive Watersheds

Sediment-sensitive watersheds consist of those water bodies listed on the Section 303d list as sediment-impaired, or which have a sediment total maximum daily load (TMDL). An

interactive web-based search engine for all waterbodies in the 303(d) list or which have a sediment TMDL can be found at following website:

http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml?wbid=CAR6341003020000207114402

No sediment-impaired watersheds nor any watersheds with a sediment TMDL were found. Therefore, it is concluded that there are no sediment-sensitive waterbodies in the study area.

B. Sensitive Beneficial Uses

To fall under this category a receiving waterbody (stream, river, lake, etc.) must be designated for all three of the following beneficial uses:

Spawning, Reproduction, and/or Early Development (SPWN)
Migration of Aquatic Organisms (MIGR)
Cold Freshwater Habitat (COLD)

The receiving water bodies with the beneficial uses as listed above are shown in Figure A1-2 and can be found at:

http://www.ice.ucdavis.edu/geowbs
http://endevour.des.usdavis.edu/wqsid/bu.asp

These sources were checked and no stream or river in the project area was found to have all three beneficial uses. The Sacramento and San Joaquin River Basin Plan (Central Valley Regional Water Quality Control Board 2009) was also reviewed. Table II-1 of this basin plan lists all streams in the in these two river basins that have designated beneficial uses. It was determined that that section of the San Joaquin River within the study area (the Friant Dam to Mendota Pool section) has the three beneficial uses necessary to classify this river as highly sensitive: spawning, migration and coldwater.

This results in a High Receiving Water Risk for those portions of the study area that drain directly to the San Joaquin River. The remainder of the project area is classified as Low Receiving Water Risk.

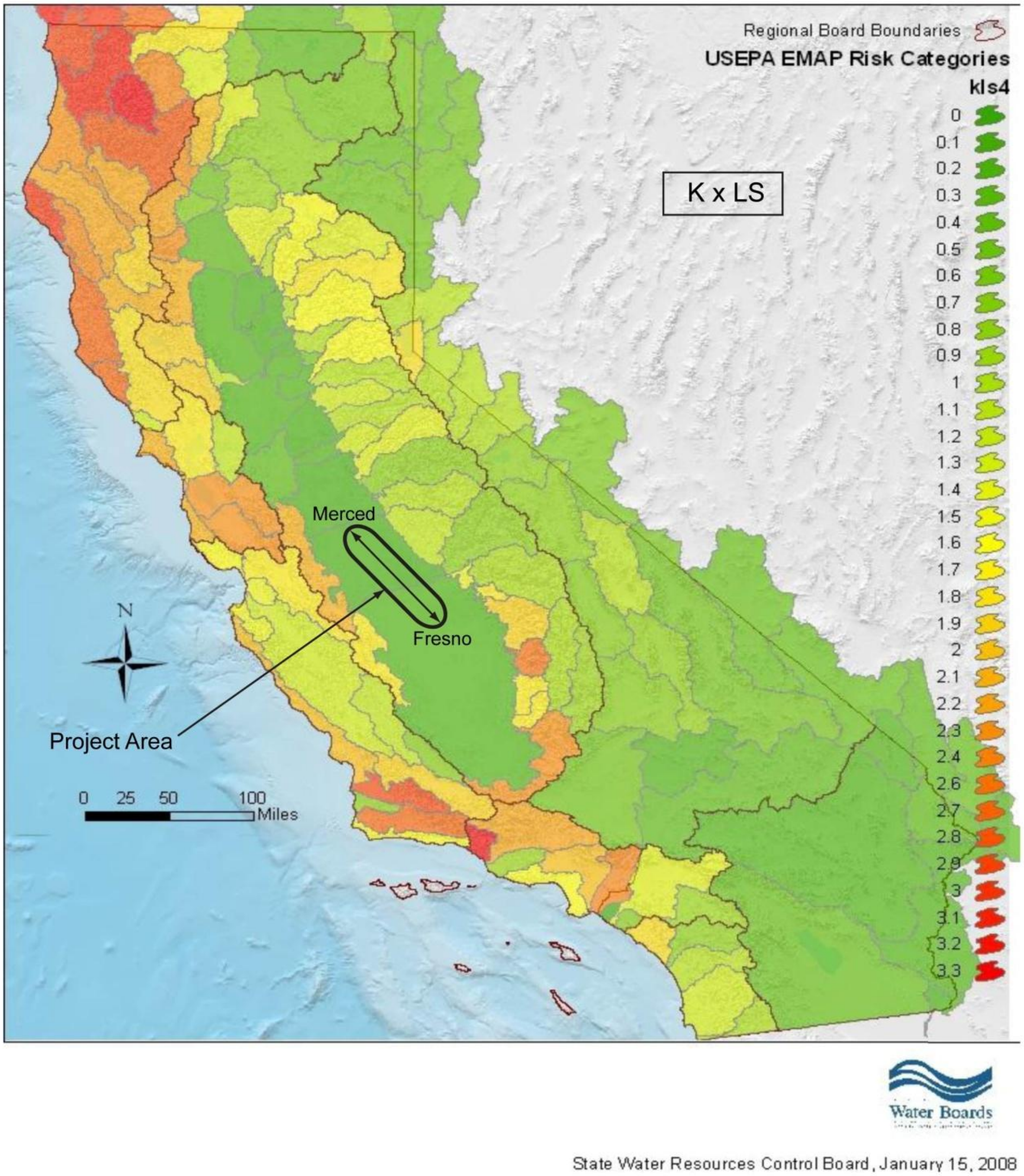

Figure A1-1
GIS Map Method

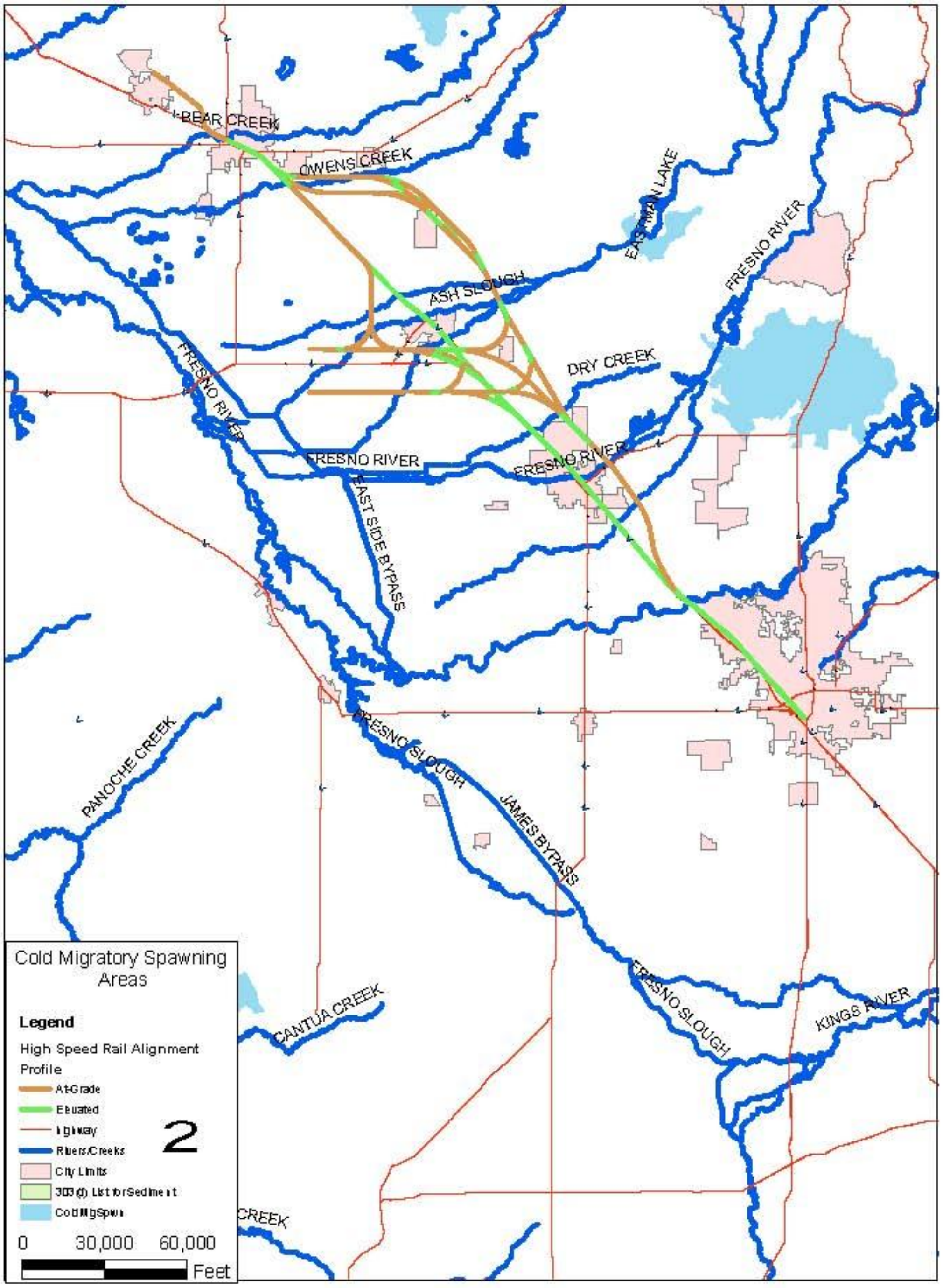

Figure A1-2
Selected Beneficial Uses

Step 3: Determine Combined Risk Level

The matrix shown below illustrates how overall risk level is determined.

<table>
<tr><th colspan="5">Combined Risk Level Matrix</th></tr>
<tr><td></td><td></td><td colspan="3">Sediment Risk</td></tr>
<tr><td></td><td></td><td>Low</td><td>Medium</td><td>High</td></tr>
<tr><td rowspan="2">Receiving Water Risk</td><td>Low</td><td>Level 1</td><td colspan="2">Level 2</td></tr>
<tr><td>High</td><td colspan="2">Level 2</td><td>Level 3</td></tr>
</table>

For the San Joaquin Watershed, the combination of Low Sediment Risk and High Receiving Water Risk results in Risk Level 2. The remainder of the project area has Low Sediment Risk and Low Receiving Water Risk. The remainder of the study area, therefore, falls under Risk Level 1.

References

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